Flood Response

MANUAL 22

Flood Response

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Australian Emergency Manual Series

The first publication in the original Australian Emergency Manual (AEM) Series of mainly skills reference manuals was produced in 1989. In August 1996, on advice from the National Emergency Management Principles and Practice Advisory Group the AEM Series was expanded to include a more comprehensive range of emergency management principles and practice reference publications.

The AEM Series has been developed to assist in the management and delivery of support services in a disaster context. It comprises principles, strategies and actions compiled by practitioners with management and service delivery experience in a range of disaster events.

The series has been developed by a national consultative committee representing a range of State and Territory agencies involved in the delivery of support services and is sponsored by the Commonwealth Attorney-General's Department.

Details of the AEM Series are available on at www.ema.gov.au

Australian Emergency Manual Series structure and content

Principles and reference manuals

Manual 2   Australian Emergency Management Arrangements

Manual 3   Australian Emergency Management Glossary

Manual 4   Australian Emergency Management Terms Thesaurus

Manual 18 Community and Personal Support Services

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Foreword

This Guide is the result of a review of the original Australian Emergency Manual **Flood Response** which was prepared in 1998-99 by a team of experienced flood response operations managers from around Australia, led by Doug Angus of the then Queensland Department of Emergency Services. The review was conducted by Andrew Gissing (Victoria State Emergency Service) and Chas Keys (formerly of the New South Wales State Emergency Service), with input from Bob Stevenson (South Australia State Emergency Service), Jeff Cheadle and Iain Macculloch (Queensland Department of Community Safety), Belinda Davies (New South Wales State Emergency Service), Trevor White and Myles O'Reilly (Victoria State Emergency Service), Mike Edwards (Victoria Department of Sustainability and Environment), Andrew Lea and Elke Browne (Tasmania State Emergency Service) and Michael Cawood (Michael Cawood & Associates). All these people have considerable experience and expertise in emergency flood response.

The Guide is one of a series of manuals on flood management whose review was instigated and managed by the National Flood Risk Advisory Group, a sub-group of the Australian Emergency Management Committee. The project was coordinated by Major General Hori Howard of the Australian Council of State Emergency Services and made possible by the financial contributions of the Commonwealth Attorney-General's Department and the Australasian Fire and Emergency Service Authorities Council.

The Guide is designed to be used by all those who have roles to play in managing floods, whether in lead or supporting agencies. These people will include emergency management practitioners and members of agencies that will be involved in flood response operations, including staff and volunteers in the State/Territory Emergency Service (S/TES) organisations which in most jurisdictions in Australia have a lead role in the management of floods.

The document is intended to provide broad guidance on all the important aspects of flood responses. It reflects considerable expertise developed over many years of flood management in the Australian states and territories. Where possible and for ease of usage by practitioners, the guidance is provided in the form of operational checklists (see Annex A).

Like the other flood management documents in the Australian Emergency Manuals series (**Managing the Floodplain, Flood Warning, Flood Preparedness and Emergency Management Planning for Floods Affected by Dams**), the Guide focuses on defining 'best practice' as this is presently understood in Australia. It does not seek to define or describe current practices, which may vary significantly between jurisdictions. Users will find it valuable to refer to the companion documents and to other publications in the Australian Emergency Manuals series.

Every attempt has been made to use neutral terminology. As a result the Guide does not use the specific terminology (for example in relation to officers, programs and management structures) or refer to the particular arrangements employed in the various states and territories.

Martin Studdert, AM
First Assistant Secretary
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Flood Response Operations

In a Nutshell…

Flood response operations involve the interpretation of flood information, the identification of possible flood consequences, making decisions about objectives and strategy, coordinating resources to undertake flood response, and making the transition to recovery and review.

Flood response operations, like other hazard management operations, are best conducted using a comprehensive approach to emergency management. This incorporates:

- *prevention,*

- *preparedness,*

- *response, and*

- *recovery.*

Recovery operations should commence as early as possible during flood response operations and continue concurrently with flood response operations.

The Flood Problem in Australia

Every year, despite the beneficial environmental impacts they create, floods impose substantial economic, social and environmental costs on Australian communities through:

- direct damage to residential, commercial, educational, recreational, cultural and industrial buildings,

- damage to infrastructure,

- damage to stock, equipment and facilities (for example farm animals, equipment, commercial stock and records and other contents of buildings),

- indirect losses due to disruption of economic activity, both in areas which are inundated and in areas which are isolated,

- stress and anxiety in those affected by flooding,

- injury and death,

- polluted water supplies, and

- damage to wildlife habitats.

In terms of economic costs to the community, flooding is Australia's most damaging natural hazard. Expressing in 2009 terms the costs estimated by the Bureau of Transport Economics (2001, p35) for flooding in Australia between 1967 and 1999, floods cost approximately $420 million per annum on average. Other sources put the average annual damage at rather higher levels when estimates are expressed in current dollar terms (see, for example, Standing Committee on Agriculture and Resource Management, 2000, p xi).

In most years, a small number of deaths occur as a consequence of flooding in Australia and there have been many cases of multiple deaths in a single flood episode. Between 1788 and 1996 at least 2213 people were killed by floods in Australia. Particularly lethal floods occurred in Gundagai (New South Wales) in 1852 (89 deaths), in the Claremont area in Queensland in 1916 (65 deaths) and in Brisbane and Ipswich in 1893 (47 deaths), but several other locations or regions have recorded more than 20 deaths in a single episode of flooding (Coates, 1996).

Large numbers of people in Australia live in flood-prone areas. Approximately 170,000 residential properties are susceptible to flooding in the 100-year ARI (Average Recurrence Interval) flood (Leigh and Gissing, 2006). The number of commercial and industrial properties liable to flooding within the extent of the 100-year flood is not accurately known but would likely be measured in the tens of thousands, and the value of the agricultural, industrial, commercial, residential and public assets that are at risk is very large as is the cost of repairing or replacing infrastructure damaged or destroyed by flooding.

Of course, many more properties, sources of productive activity and critical items of infrastructure would be affected in floods bigger than the 100-year flood. It is probable that the total value of the assets at risk in Australia in Probable Maximum Flood (PMF) events – the biggest floods possible – considerably exceeds $100 billion.

The 'Manageability' of Flooding

Flooding is a highly manageable hazard where the flood risk can be defined and appropriate emergency preparedness and mitigation strategies developed. Floods happen often in Australia and, in some areas, according to a regular seasonal rhythm. Their location is predictable and there is usually some warning of their occurrence. Often it is possible to determine who will be affected and what problems will be encountered as far as warning, evacuation, property protection, rescue, resupply and other functions are concerned. Much can therefore be known about a flood and its likely consequences before it occurs. Because of this, the opportunity exists to work out in advance (ie to plan) how a flood can be best managed in the interests of maximising public safety and minimising property and other

damage. This allows for the investment of money and effort in the management of flooding.

To reduce the negative impacts of flooding, many measures have been devised to help communities adjust to and live with the flood hazard. These measures have included:

- constructing levees, flood bypasses, channel improvements, detention basins and flood mitigation dams,

- instituting land use controls (such as zoning and the removal of existing buildings) and building restrictions (such as establishing minimum floor levels and raising buildings) in relation to development on flood-prone land,

- developing warning systems,

- developing response and recovery capabilities, and

- encouraging community understanding of both the flood threat and the means by which people can manage it.

While these measures rarely remove the flood risk entirely, they can modify the characteristics of flooding, alter communities in ways that reduce the impact of floodwaters and provide mechanisms that enable communities to cope better with flooding. For more detail on these measures, see Annex B of the Australian Emergency Manual **Managing the Floodplain**.

Preparing for floods through flood emergency planning, exercising and community engagement enables a proactive response to flooding to be made. Responses to floods are best conducted when these tools have been well developed, but on occasions it is necessary to respond to flooding in circumstances in which the tools are non-existent or poorly established. This manual seeks to set out the principles of flood response whether or not the tools of preparation have been developed.

High-quality flood response makes a real contribution to the task of reducing the costs, economic and other, which floods impose on communities. To that extent it contributes significantly to the processes of building community resilience against the flood hazard.

The Nature of Flood Response Operations

Coordinated flood response is essential to the management of flood risk. Flood risks include:

- inundation of properties;

- isolation of communities and individual properties; and

- indirect effects as a consequence of infrastructure damage or interruption.

Flood response operations involve the following sequential stages:

- the interpretation of flood information including Flood Warnings, Flood Watches, Severe Weather Warnings, Severe Thunderstorm Warnings or observations of heavy rainfall or stream rises,

- identification and understanding of potential flood consequences with reference to flood intelligence,

- decision making and the development of operational action plans about what response strategies are necessary to manage flooding with reference to flood emergency plans and standing operating procedures (SOPs),

- coordinating the execution of flood response strategies such as warning, reconnaissance, evacuation, resupply, rescue and property protection,

- the transition to recovery, and

- review.

This sequence of actions is illustrated in the flow chart opposite (Figure 1).

Tasks in a Flood Response Operation

In its simplest form, a flood response operation could consist of:

- distributing warnings and other flood-related information to the community,

- ensuring essential services are maintained or quickly re-established,

- maintaining access routes,

- protecting, maintaining and repairing existing structural mitigation works,

- constructing expedient mitigation works (such as temporary levees),

- securing areas,

- conducting search and rescue operations,

- evacuating persons and providing for their immediate welfare,

- protecting property and possessions,

- coordinating the essential needs of isolated persons and communities,

- coordinating the immediate welfare of stranded travellers, and

- ensuring the welfare of flood-affected animals (pets and farm livestock).
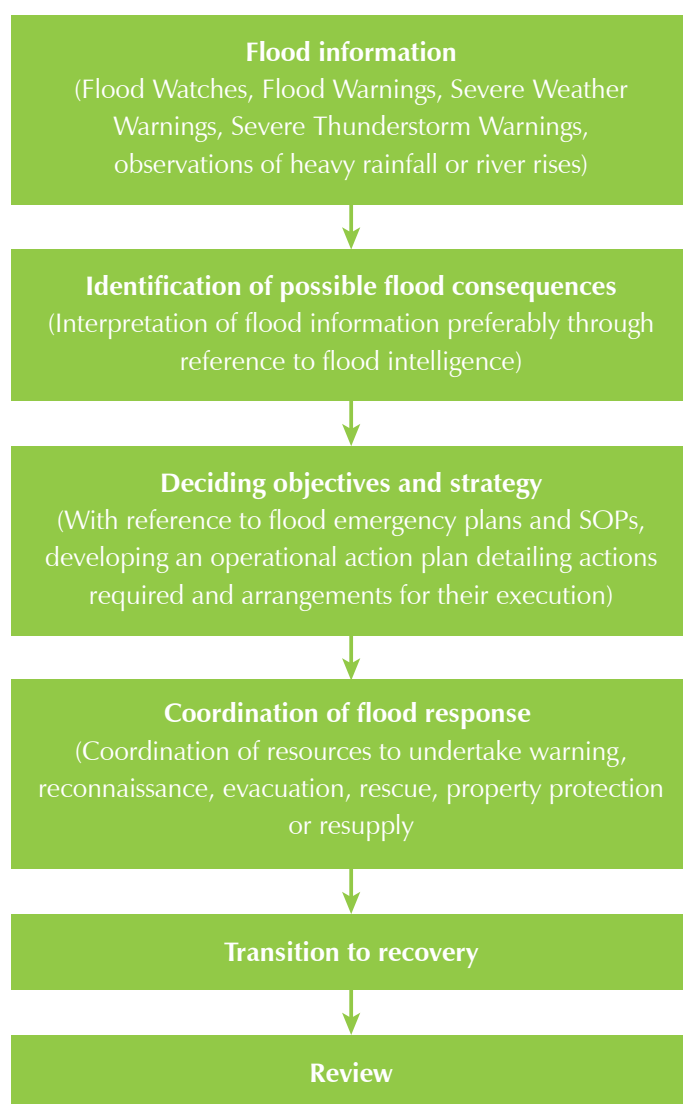
Figure 1: The Sequence of a Flood Response Operation

Flood Response Operations within the Overall System of Emergency Management

'Response' is one of the four elements of a comprehensive approach to emergency risk management, commonly known as 'PPRR'. These, in the order in which they are usually placed, are to:

- **prevent** the impact or reduce its severity,

- ensure **preparedness** and readiness within the community,

- provide an effective **response** immediately following any hazard impact, and

- provide for the **recovery** of the community.

Typical measures in the context of flooding may include the following under each of the four elements.

Prevention

- Zoning and land use management

- Legislation

- Building codes

- Public information

- Building use regulations

- Community awareness/education

- Relocation of buildings

- Safety improvements

- Tax, insurance incentives and disincentives

Preparedness

- Community awareness and education

- Mutual aid agreements and memoranda of understanding

- Flood emergency plans

- Warning systems

- Training and test exercises

- Resource inventories

- Emergency communications

- Provision of special resources

- Evacuation plans

Response

- Implementation of plans

- Notification of public authorities

- Implementation of emergency legislation/declarations

- Keeping the public informed

- Providing medical assistance

- Issuing of warnings

- Providing immediate relief

- Activation of operations centres

- Conducting search and rescue activities

- Mobilisation of resources

- Carrying out evacuation

Recovery

- Establishment of recovery centres

- Provision of community and individual recovery services, including:

  - personal support

  - food, clothing and temporary accommodation

  - health and safety advice

  - information

  - practical advice

  - clean-up.

- Provision of physical recovery services including:

  - restoration of essential services

  - management of public and environmental health issues

  - reconstruction and redevelopment of infrastructure

  - provision of economic recovery services

  - implementation of financial assistance schemes

  - management of public appeals

  - insurance.

It is important to note that these four major elements are not sequential. For example, recovery operations must begin while flood response operations are still occurring. The four PPRR elements are **aspects** of management, not phases.

Successful emergency management depends on the comprehensive approach being followed. All four aspects need to be addressed to reduce the likelihood of death or injury within a community, to reduce property damage and to minimise disruption of the community's normal activities.

The Management of Flood Response Operations

In a Nutshell…

Flood response operations can be managed by:

- *a designated lead agency, or*

- *the overall emergency management structure.*

Establishing control over a flood response operation involves gaining control over:

- *the area,*

- *resources, and*

- *the likely effects of the flood.*

General principles to be applied to flood response operations are:

- *response and initial recovery operations should commence at local level,*

- *lead agencies must be able to deploy additional resources under their own authority, and*

- *agencies responsible for preparedness, response and recovery operations should be allowed to carry out their normal roles.*

An incident management system should be used. The Australasian Inter-Service Incident Management System (AIIMS) and its variants are now used extensively across Australia.

Types of Operational Management

Flood response operations can be managed in two different ways, by:

- a designated lead agency, or

- the overall emergency management structure;

Operations Managed by the Lead Agency

In this situation the operation is managed by the operational head of the lead agency acting as the Operations Controller. During lower levels of flooding the management task may be limited to controlling the activities of the lead agency. However, most flood response operations will involve supporting agencies which will provide their support directly to the lead agency. In this type of operation the emergency management structure does not provide the control – the lead agency does. However, the emergency management structure may coordinate support to the lead agency if required. This type of management can only be effective where the lead agency has the authority enshrined in legislation or plans for the management of such operations and has the responsibility to coordinate flood emergency planning.

Operations Managed by the Emergency Management Structure

In this case the operation is managed by a person in a specific controlling position within the emergency management structure. This person becomes the Operations Controller. Participating agencies perform specified tasks within the overall operation and will be relied upon to provide specialist advice to the Operations Controller. The distinguishing feature of this type of operation is that agency leaders respond to meet the requirements of the Operations Controller.

Criteria to Address

Regardless of the management system which applies, the following management criteria should be noted:

- the organisation responsible for flood response operations should be made responsible for flood emergency planning, or at least be required to forge close links with it,

- the organisation responsible for flood response operations should be responsible for flood intelligence, or at least have close links with it and be involved in the establishment of flood warning systems,

- the flood response management system should be designed so operations are managed initially at local level, but should allow for escalation to District or Region and State level as necessary, and

- responsibilities of all participating and supporting agencies should be laid down in detail in either emergency plans (DISPLANS or other general operational plans) or flood emergency plans.

Control, Command and Coordination

The management of flood response operations involves emergency managers exercising control, command and coordination. It is important to ensure these terms are well defined within flood emergency plans and understood by emergency managers. Here, the terms are used as defined in the AIIMS Handbook (Australasian Fire Authorities Council, 2005).

Control is the overall direction of emergency management activities in an emergency situation such as a flood. Authority for control is established in legislation and may be included in an emergency plan. It carries with it the responsibility for tasking other organisations in accordance with the needs of the situation. Control relates to situations and operates horizontally across organisations.

Command is the internal direction of the members and resources of an agency in the performance of the organisation's roles and tasks, by agreement and in accordance with relevant legislation. Command operates vertically within an organisation.

Coordination is the bringing together of organisations and other resources to support a response operation such as a flood operation. It involves the systematic acquisition and application of resources (organisational, human and equipment) in an emergency.

Establishing Control

One of the most difficult tasks confronting an Operations Controller can be to establish effective control over a flood response operation. During a flood which develops slowly, control measures may be established progressively as the water rises. However, in the case of flash flooding, control may have to be established quickly to minimise loss of life, injury or damage to property.

Establishing control has three elements which must be attended to concurrently. Control must be established over the:

- area,

- resources, and

- nature of the problem.

Establishing Control over the Area

Establishing control over the area during a flood requires the Operations Controller to:

- arrange reconnaissance to define the actual or likely extent of the inundated area,

- define the present and potential inundated areas and ensure all appropriate agencies are advised of the location and outer limits of present and likely inundation,

- review flood intelligence to establish the likely effects of the flood on people and property,

- find out what routes in to and out of the area are usable and by what type of vehicle,

- designate access and egress routes for response personnel and others,

- establish perimeters or cordons to control movement into and through the area if required, and

- advise the community of what measures should be taken to protect themselves and their property, of what they should and should not do, and of the current and expected situation.

Establishing Control over Resources

Establishing control over resources includes the need to:

- establish liaison with resource providers,

- find out from other agencies:

- what resources they have in the affected area,

- which of those resources are available for tasking and at what time, and

- what additional resources they might need or can deploy to the area from outside using their single agency arrangements.

- find out from the next higher level of control what back-up resources are available to be called upon,

- establish and advise reporting arrangements for incoming resources,

- establish reporting or assembly areas to which resources can be sent to wait for further tasking, and

- decide what is the best system of control of all major resources and advise all agencies so everyone knows who is in charge of each element.

Establishing Control over the Problem

Establishing control over the problem includes the need to:

- determine the exact nature of the problem in terms of

  - numbers of casualties and deaths,

  - details of persons needing evacuation or other assistance,

  - details of persons needing resupply,

  - details of persons needing rescue,

  - details of persons requesting property protection,

  - numbers and locations of buildings destroyed or damaged, and

  - actual or potential damage to essential infrastructure.

- determine how the nature of the problem may change as the flood develops,

- decide what can be done to minimise further damage,

- establish a system of priorities for responding to specific problems,

- establish a system for allocating personnel and resources to tasks on an individual basis, or by sectors, or by discrete incidents, and

- keep the community informed.

Tying it Together

Once control is established over these three aspects the Operations Controller is able to plan for and direct the most effective and appropriate response. As much of the above as possible should be arranged before a flood as part of preparing a community for flooding (ie through the flood emergency plan).

However, under some circumstances these matters may need to be addressed in a short time frame or, in the worst case, as the flood is occurring.

The Principles of Flood Response Operations

The following principles, which apply to emergency management operations in general, also apply during management of a flood response operation:

- Responsibility for response and initial recovery should rest initially at local level. If local agencies and available resources cannot cope they are augmented by those at District level. If these also cannot cope, support coordinated from the State, and possibly resources provided from the Commonwealth and other States and Territories, are used.

- Designated flood lead agencies must be permitted to deploy additional resources from their own service from outside the affected local area or district if they are needed to conduct operations.

- Preparedness, Response and Recovery operations should be conducted with all agencies carrying out their normal functions or functions which their training and equipment is best suited for wherever possible.

Use of the Australasian Inter-Service Incident Management System

Whichever management system is adopted for responses to floods must be clear in its provisions and flexible in its application. While the use of any particular system cannot be mandated, the Australasian Inter-Service Incident Management System (AIIMS) and its variants are now used extensively across Australia to manage emergency responses including responses to floods. AIIMS can be described as "a flexible system that builds with the incident, with overall responsibility vested in the Operations Controller" (Australasian Fire Authorities Council, 2005).

AIIMS provides a structure and process of delegation to ensure that all vital management and information functions are adequately performed. The system is made up of four functional areas: control, planning, operations and logistics.

During the initial response to a flood, the Operations Controller may perform all of these functions. As the incident grows and its management becomes more demanding, any or all of the functions of planning, operations and logistics may be delegated.

Once the Operations Controller appoints delegates to any functional role, an Operations Management Team results. The Operations Management Team comprises those people responsible for the four functional roles of control, planning, operations and logistics.

It is essential that personnel with a thorough knowledge of flood intelligence are incorporated into the operations management team.

Information on Developing Floods and the Identification of Flood Consequences

In a Nutshell…

Flood operations involve the receipt and interpretation of flood information. Flood information can include formal flood warning products and observations of heavy rainfall or stream rises.

Flood information must be interpreted to identify possible flood consequences using flood intelligence.

It is often difficult to identify the potential specific flood consequences in flash flood environments where no gauge height predictions are available.

Decision makers should have a clear appreciation of the level of accuracy of the flood intelligence they are using.

During flood operations it may be possible to use the expertise of flood or drainage specialists with knowledge of the specific flood problem in the affected area. Such specialists may be employed by local councils, state government agencies or consultancy firms.

Types of Information on the Development of Flooding

Numerous different types of flood information indicate that flooding may occur. These range from official warnings to unofficial advice and observations.

The Australian Government Bureau of Meteorology is the primary source of official flood warnings in Australia. The Bureau provides the following products to flood emergency managers and the community:

- **Flood Watch.** A Flood Watch is a notification of the potential for a flood to occur as a result of a developing weather situation. It consists of short generalised statements about the developing weather including forecast rainfall totals, description of catchment conditions and catchments at risk. The Bureau of Meteorology attempts to estimate the magnitude of likely flooding in terms of the adopted flood classifications. Flood Watches are normally issued 24 to 36 hours in advance of likely flooding and on a catchment wide basis.

- **Preliminary Flood Warning.** These warnings usually predict which class of flooding (minor, moderate or major) will occur rather than providing quantitative forecasts. A Preliminary Flood Warning is the first in a series of warnings and will typically be followed by more detailed flood warnings.

- **Flood Warning.** A Flood Warning is a gauge-specific forecast of actual or imminent flooding. Flood Warnings specify the river valley, the likely severity of flooding (often in terms of flood heights at gauges) and when it will occur. They are provided as predicted river level heights at the locations of specified gauges.

- **Severe Weather Warning.** A Severe Weather Warning is issued when severe weather is expected to affect land-based communities within the next 24 hours; and:

  - it is not directly the result of severe thunderstorms, and

  - it is not covered by tropical cyclone or fire weather warnings.

  Severe Weather Warnings aim to provide advance notice of very heavy rainfall leading to flash flooding, or of a storm surge which is sometimes exacerbated by abnormally high tides.

- **Severe Thunderstorm Warning.** These warnings are issued whenever severe thunderstorms are occurring in an area or are expected to develop or move into the area during the ensuing few hours. The warnings describe the area under threat and the particular hazards likely to be associated with the thunderstorms including flash flooding.

In addition to the Bureau of Meteorology, Local Government Councils or State Government Departments and Authorities may provide flood warnings. These entities typically operate flood warning systems in flash flood catchments.

Often, local communities with substantial flood experience may operate their own unofficial flood warning systems. Such systems, operated by community members, use locally developed techniques to predict flood levels at certain gauging points along a stream. Emergency managers should seek to engage with the leaders of such systems and, where appropriate, facilitate communication with official warning agencies regarding flood predictions.

Observations of heavy rainfall and/or stream level rises are also important environmental signals of potential flooding. Such observations can be of particular importance in flash flood environments, where little warning time exists and often official flood warning systems have not been developed.

Rainfall and stream level information is available from the Bureau of Meteorology website (www.bom.gov.au). In some areas rainfall and stream level gauges may be equipped to provide alarms to flood management agencies to provide an early alert that sufficient rainfall may be falling to produce flooding. Such alerts can be used to improve the situational awareness and operational preparedness of emergency managers.

Communication between the lead agency and the flood prediction agency is essential to ensure accurate knowledge regarding flood predictions and the developing weather situation. Emergency managers will also be able to pass information to the flood prediction agency regarding current local flood consequences and levels on ungauged streams.

It is essential to ensure that processes are in place for flood emergency managers to receive flood information, whether from the Bureau of Meteorology or from 'spotters' in various parts of relevant catchments.

Interpreting Flood Information

Often, official flood warnings will use certain terms to describe flood predictions. These terms are explained below:

- **Peak.** This is likely to be the maximum flood level measured at a specified gauge in the current flood. Predictions of flood peaks are typically made once rainfall has eased for some time and upstream maximum levels have been achieved.

- **Reach.** This is the highest flood level expected based on existing and/or forecast rainfall. However, the warning agency is not yet confident to predict a peak level, as possible further rainfall and/or upstream tributary inflows may result in a higher level than that predicted.

- **Exceed.** The flood level is expected to rise past this height, and peak at a higher level. This term is used when heavy rainfall is still falling and/or upstream peaks are still uncertain.

For example, a warning message might say: 'This flood is expected to peak at a height of 6.0 metres' at a specified gauge.

Predictions of flooding are often expressed in terms of flood classifications which express the anticipated flood severity as 'minor', 'moderate' or 'major'. These terms are explained below using the current national definitions:

- **Minor flooding.** This is flooding which causes inconvenience such as closing of minor roads and the submergence of low-level bridges. The lower limit of this class of flooding, on the reference gauge, is the initial flood level at which landholders and/or townspeople begin to be affected in a significant manner that necessitates the issuing of a public flood warning by the Bureau of Meteorology.

- **Moderate flooding.** This is flooding which inundates low-lying areas, requiring removal of stock and/or evacuation of some houses. Main traffic routes may be flooded.

- **Major flooding.** This is flooding which causes inundation of extensive rural areas, with properties, villages and towns isolated and/or appreciable urban areas flooded.

Identifying Likely Flood Consequences

To enable an Operations Controller to make appropriate decisions regarding what objectives and strategies will be required to respond to a developing flood, the possible consequences of the flooding must first be identified so that the potential flood problem is fully understood.

Using Flood Intelligence Records

The identification of flood consequences is made by reference to **flood intelligence** (sometimes referred to as flood information). The development of flood intelligence systems is detailed in Chapter 2 of the Australian Emergency Manual **Flood Preparedness** and is discussed only briefly in this section.

Flood intelligence is the product of a process of gathering and assessing information to assist in the determination of the likely effects of a flood upon a community. These effects vary with the scale of flooding, and flood intelligence is typically presented in terms of the relationship between flood consequences and flood severity (often measured as a gauge height).

This information is typically presented in the format of flood intelligence records which are developed for the **reference area** around a stream gauge, both upstream and downstream. This is the area for which gauge heights have meaning in terms of riverine flooding, independent of local flooding or flooding from tributary creeks. Further detail on reference areas is provided in Chapter 4 of the Australian Emergency Manual **Flood Warning**, and an example of detailed flood intelligence records for such an area can be found in Annex B of the Australian Emergency Manual **Flood Preparedness**.

Flood intelligence records are used to interpret and give meaning to flood height predictions. They allow the reader to develop an appreciation of potential flood severity through an understanding the relationship between predicted heights and flood consequences.

Using Geographic Information Systems

'Flood extent' maps, such as those for the 5%AEP, 1%AEP and PMF and derived for land use planning purposes, have limited value during flood response operations. Flood warnings make no reference to the AEP of a coming flood, and designed flood extents make assumptions about the rainfall and catchment conditions that would be unlikely to be matched in any real flood scenario. The design flood extent for the PMF, however can be used to represent the upper limit of the flood-prone area.

More sophisticated flood intelligence systems have been developed which use Geographic Information Systems (GIS) to provide spatial maps and allow visualisations of potential flood consequences from flood height predictions. The use of GIS is increasingly common as a real-time planning tool which makes it easy for emergency managers to visualise the extent and probable consequences of a developing flood.

The principal use of GIS during a flood response involves inputting a predicted flood height and interrogating against features of specific interest eg locations at which roads may be cut, the inundation of important infrastructure and the likely time available to act before inundation or isolation take place. Note that the products of a GIS are **approximate** rather than precise and due note must be taken of the limits to the **level of resolution** they can provide. Nevertheless, using a well-developed GIS can be of great benefit to operational decision making during floods, especially in the context of recognising potential problems to ensure that actions in relation to functions such as warning, evacuation, property protection and resupply are undertaken in a timely fashion.

Further information on GIS, especially in relation to the depiction of inundation, can be found in Chapter 2 of the Australian Emergency Manual **Flood Preparedness**. Applications to flood warning are covered in Chapter 4 of the Australian Emergency Manual **Flood Warning**.

Understanding Flood Consequences in Flash Flood Environments

It is difficult to interpret the potential specific flood consequences in flash flood environments where no gauge height predictions are provided and rainfall information may be the only data available. In these cases it is important to conduct reconnaissance of low-lying areas (where it is safe to do so) to ensure that the development of flooding is properly identified. In many cases it will be necessary to adopt a worst-case appreciation of possible flood consequences, based upon whatever flood mapping is available.

Accuracy

Decision makers should appreciate the limitations on the accuracy of the flood intelligence they are using. All flood intelligence records are approximations. This is because no two floods at a location, even if they peak at the same height, have identical impacts. The gradients of the floods may differ, they may be at or close to their peaks for different durations, there may have been land-use changes between the flood events, flood mitigation structures may have changed in the interim and the channel and floodplain environments in which flooding occurs are unlikely to be the same.

Communication with Experts

Often it will be possible to use the expertise of local flood or drainage experts who may be employed by local or state governments to assist with the identification of flood consequences. Consultants with knowledge of specific flood scenarios may also be hired to assist.

In cases where levees or other flood mitigation works are involved, it is essential that there is liaison established between the lead agency and the organisation responsible for the management of structural mitigation structures. This will allow for communication and understanding to be developed regarding the current status of mitigation structures and their potential impacts on flood consequences.

Geographic Information System Applications in New South Wales

The New South Wales State Emergency Service utilises a simple spatial flood intelligence system on the Georges River which flows through the southern suburbs of Sydney. The system allows a user to enter a flood height prediction and produce a display of all properties which may be inundated at the predicted height. The system works through the querying of a database which includes information on flood levels and floor levels for individual properties as well the heights of critical roads. Figure 2 shows a display from this system: portrayed are the commercial and residential properties likely to experience overground and over-floor inundation, and the major roads likely to be covered by floodwaters, in a flood forecast to reach the heights shown (see top left of figure) for the Liverpool Weir and Milperra gauges.

A GIS has also been developed to depict the probable consequences of flooding to various forecast gauge heights on the Hawkesbury-Nepean River (Figure 3). To allow operations centre personnel to better visualise the key consequences and extent of predicted flooding, the tool produced by the New South Wales State Emergency Service calculates flood levels across the floodplain by smoothing the surface of a flood from predictions from a number of gauges. The system utilises predicted flood levels at key warning gauges to interpolate likely flood levels between the gauges and across the floodplain. It calculates levels using the results of an established set of rainfall/ runoff and flood routing models and generates results for display in a GIS format. Where height information is available for road inundation points, properties and infrastructure, result files can be created indicating the interpolated depth of flooding and the estimated peak height at those locations. Figure 3 depicts the situation in a flood predicted to reach a height of 13.9 metres at the Windsor gauge: this represents an event approximating the 0.5% AEP flood at that location.
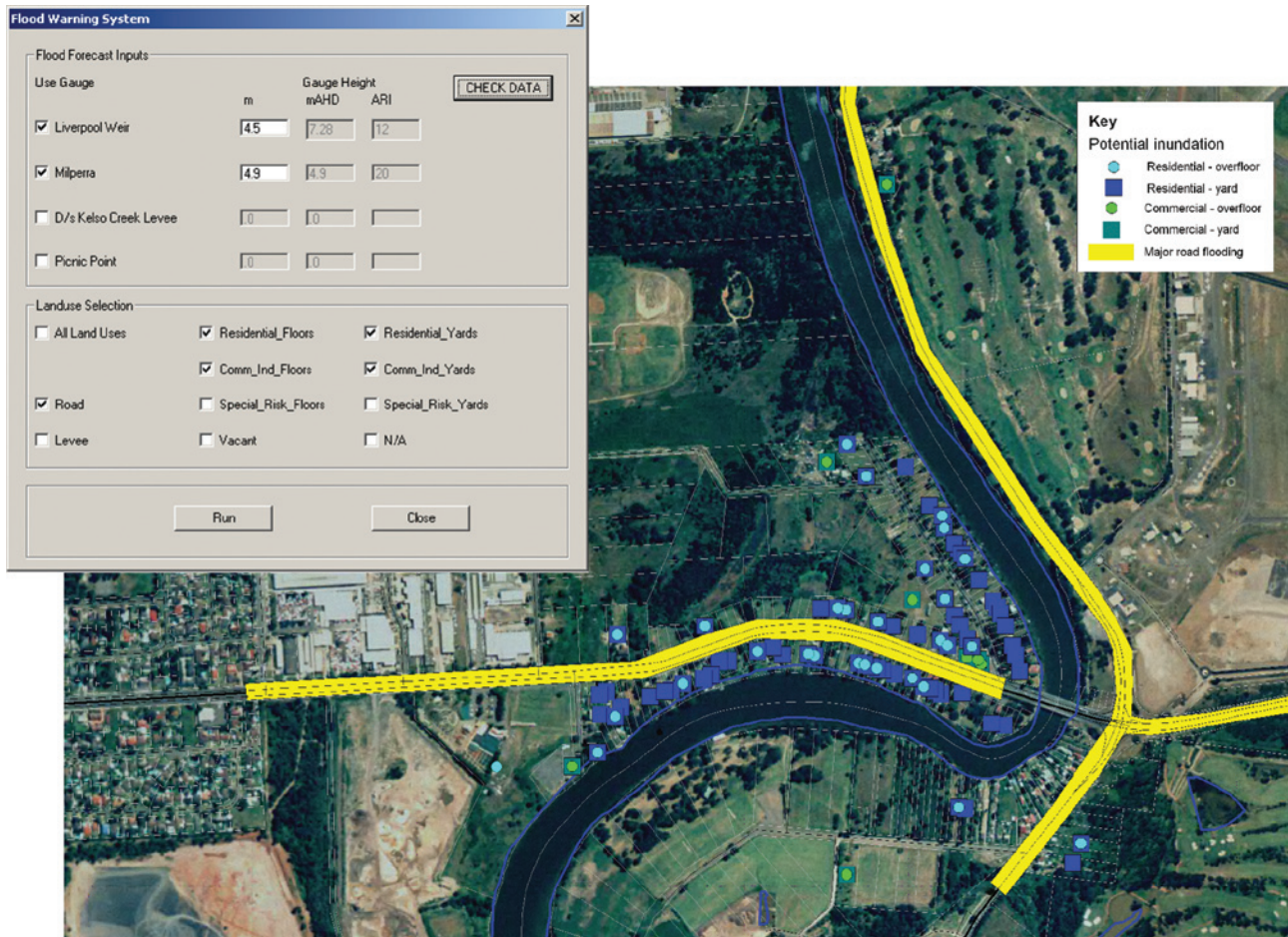
Figure 2: Geographic Information System Display, Milperra, Georges River
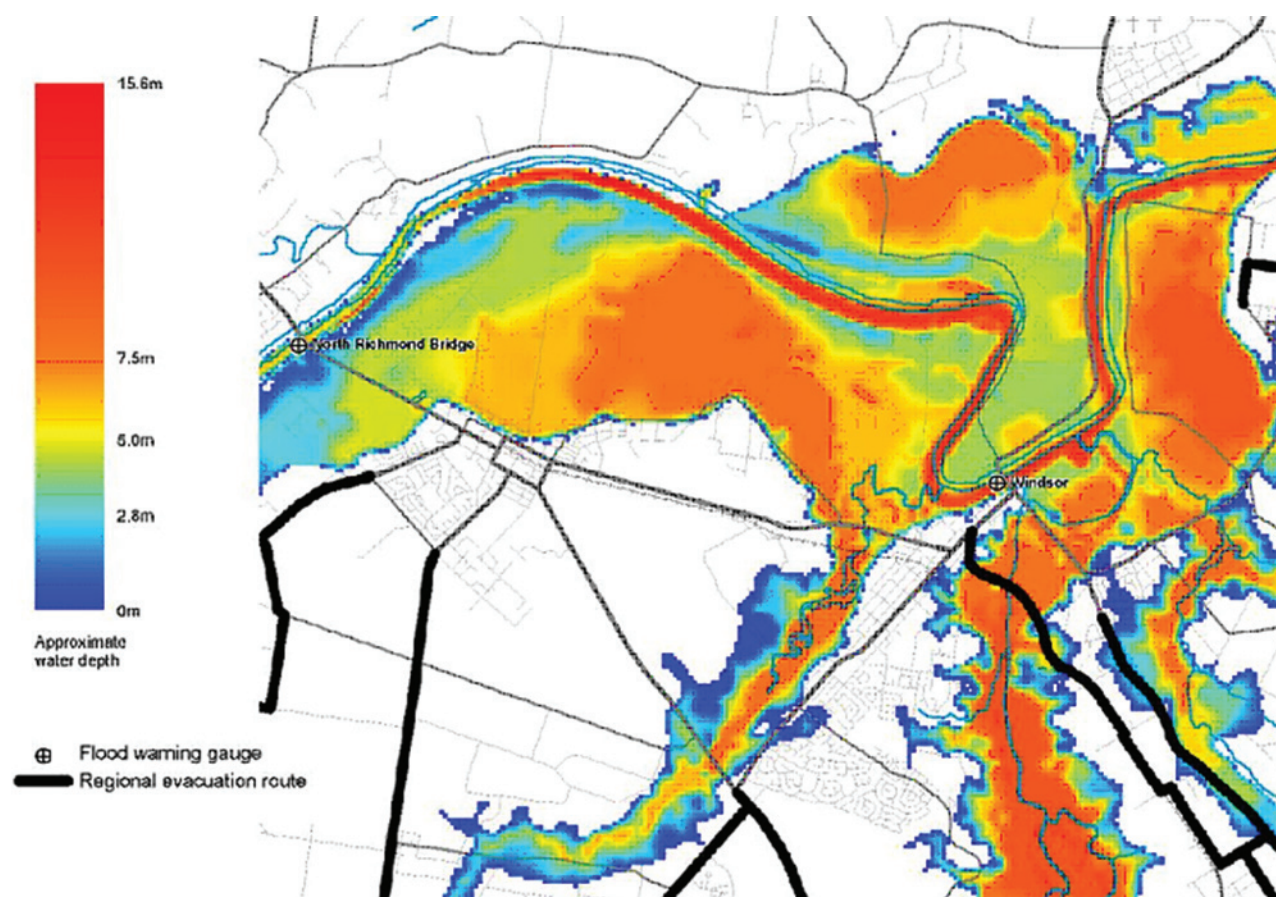
Figure 3: Information Display, Richmond and Windsor Areas, Hawkesbury-Nepean River

Deciding Objectives and Strategy

In a Nutshell…

Often decisions will need to be made early in the developing stages of a flood under the pressure of time and without the benefit of complete information.

Objectives are important in setting directions for flood response operations and should clearly communicate to all involved what is to be achieved. Once objectives are determined, strategies can be developed to ensure they are achieved.

Objectives and strategies should be detailed in an Operational Action Plan and distributed widely, including to supporting agencies.

The habit of looking ahead, using flood intelligence, must be cultivated.

Making Decisions

After developing an appreciation of likely flood consequences in a developing flood event, an appreciation of the following should have been identified:

- what areas may become inundated, to what extent, to what depths and with what velocities,

- what areas may become isolated, to what extent and for what period of time, and

- what areas may become indirectly affected, in what ways and to what extent.

Often decisions will need to be made during the developing stages of a flood, under significant time pressures and with only incomplete information. These decisions and plans need to flexible in relation to their expected outcomes and in their execution. As more information is gathered, collated and interpreted, it will be possible to reconsider previous decisions and plans to improve responses.

In addition to the consequences of flooding, decision makers will need to consider:

- the time of day,

- the current and future weather situations,

- the current status of infrastructure such as roads which may be critical to the implementation of the operational strategies,

- characteristics of the at-risk population,

- the time needed to complete response operations,

- the time available to complete operations,

- resources required to complete operations, and

- resources available to complete operations.

Deciding Objectives

Objectives are critical to flood response management. Objectives should communicate clearly to all those involved what is to be achieved. Operational objectives are often well defined in flood emergency plans and may include:

- protection of life,

- minimisation of damage to property,

- minimisation of interruption to essential services,

- minimisation of damage to the environment,

- the safety of flood response personnel, and

- initiation of recovery.

Strategies need to be developed to achieve the operational objectives. For each risk identified there are certain strategies which can be undertaken to manage flood consequences and hence reduce the overall flood risk to people, properties and infrastructure.

Table 1 below lists emergency response strategies that are available to emergency managers and what sources of risk they can be used to manage.

Table 1: Strategies and Sources of Risk

	Source of Risk		
	Inundation	**Isolation**	**Indirect Effects**
Warning	✓	✓	✓
Property Protection	✓		
Evacuation	✓	✓	✓
Rescue	✓		
Resupply		✓	✓

Developing an Operational Action Plan

Operational action plans provide operation-specific information regarding the objectives and strategies that have been decided and how they will be executed and coordinated over a period of time. To accomplish each objective, the operational action plan must provide clear strategic direction and outline the coordinated sequence of actions required. The development of the operational action plan is usually the responsibility of the planning officer within the operations management team in consultation with other team members and the Operations Controller.

All operational action plans must be approved by the Operations Controller. Once approved, operational action plans should be distributed to all flood response units and supporting agencies so as to clearly communicate objectives and strategies.

Flood emergency plans and standing operating procedures (SOPs) should be referred to when developing an operational action plan so as to ensure that they are consistent with the principles, objectives and strategies outlined in these documents.

The Importance of Looking Ahead

It is vital that Operations Controllers and their staffs cultivate the habit of **looking forward** in time, using flood intelligence, to identify the likely impacts of a developing flood (eg in terms of the areas which will probably be inundated, the roads which may close and other potential effects). Many flood operations are less successful than they might have been because flood effects are not anticipated and management decisions accordingly are either not taken or are taken too late to be implemented effectively. In the worst case, failure to look forward means that flood management is **reactive** to what has already occurred rather than **anticipatory** of what may happen.

Many post-emergency reports and enquiries (including coronial enquiries) have criticised emergency response operations for lacking a forward-looking focus. Sometimes the lack of such a focus leads responders to react to **achieved** triggers (eg in a flood context the overtopping of a levee) rather than in **anticipation** of the overtopping which can usually be forecast by applying flood intelligence to flood predictions. In this case the result of failing to look forward may be the need to mount a large-scale rescue operation when an evacuation operation could have been undertaken at an earlier time. Such a rescue operation, it might be said, is likely to represent a case of 'failed evacuation'.

Situation reports which deal largely with current conditions and activities are often an indication of inappropriate mindsets on the part of emergency personnel. This mindset usually exists because operators feel constrained in making judgements about what might happen and believe that they must have certainty before making decisions. This is not so. Certainty about future flood impacts is often

not available, but emergency management decisions can (and indeed must) be made on the basis of what is likely or possible. The costs of potential over-reaction in this context are almost always less than the costs of under-reaction or delayed reaction; moreover the latter are invariably more difficult to explain in the aftermath.

Looking ahead, as far as the development of a flood is concerned, is obviously more difficult in flash flood situations than in situations in which floods develop slowly.

Coordinating Flood Response Strategies

In a Nutshell…

Flood response operations should be controlled from a specifically established flood operations centre.

Liaison is provided from supporting agencies to the lead agency.

Liaison Officers must be able to:

*   *advise the flood Operations Controller about their own agency's capabilities,*

*   *commit the resources of their own agencies, and*

*   *pass and obtain situation reports.*

The establishment of 'functional areas' is an effective way of coordinating specialist resources such as engineering resources.

The Operations Controller will need to know the status of roads in the operational area and will require a system to pass road information to all supporting agencies and the public.

Flood Response Operations Centres

Floods are managed from an operations centre, the function of which is to assist the Operations Controller conduct flood response operations. It will also:

*   monitor operations,

*   coordinate support,

*   liaise with all agencies involved in the flood operations, and

*   pass information to other agencies and the community.

Operations centres fall into one of two categories, mirroring the two types of management structure noted in Chapter 2. They are:

*   lead agency operations centres, or

*   emergency operations centres.

Lead Agency Operations Centres

In a lead agency operations centre, the Operations Controller **commands** the lead agency personnel and resources committed to the operations. The Operations Controller:

*   sets tasks, by directing **what** is to be done, and

- sets times and priorities, by directing **when** the task is to be done; and may direct **how** the task is to be done (but only by elements of the lead agency).

In all but low-level floods, the lead agency will be supported by other agencies. These agencies will be **controlled** by the lead agency rather than commanded. That is, they will be tasked and given timings, but left to determine how the tasks will be accomplished.

Emergency Operations Centres

An emergency operations centre:

- **monitors** an operation conducted or managed by a lead agency,

- **coordinates resources** in support of a lead agency, and

- **directs** an operation or part thereof (for example an evacuation operation) if requested by the lead agency.

The Functioning of Flood Operations Centres

In order to carry out its functions, an operations centre (whether it is a lead agency operations centre or an emergency operations centre) will, upon activation:

- establish communication with all agencies and activate those which are likely to be needed,

- review flood emergency plans and intelligence and confirm the details of the flood risk,

- seek additional information, often by reconnaissance,

- provide information to the community at risk,

- alert recovery agencies,

- marshall resources,

- make operational decisions,

- keep a record of events, and

- review the accuracy of flood intelligence.

Staffing

The staffing of the operations centre should be determined by the Operations Controller, who will delegate functions as appropriate. Staff will be needed to cover operational planning, the maintenance of displays, plotting and log-keeping, public information and media, resource coordination and general clerical, keyboard and other support.

At the local level some of these functions may be combined due to either a lack of facilities or a lack of trained staff. In some circumstances it will be prudent to bring people in from outside to meet these functions.

Liaison

Liaison with police and all supporting agencies is essential during flood response operations. The basic principle is that **liaison is provided from the supporting agencies to the supported agency**.

Liaison officers must be able to:

- advise the Operations Controller of the capabilities and status of their parent agencies,

- commit the resources of their parent agencies, and

- pass and receive situation reports to and from their agencies.

At the local level in particular, the supporting agency commander/manager may be the most appropriate liaison officer for particular flood response operations, because he/she can commit resources. However, it is best practice to authorise all liaison officers to commit resources.

It will not always be necessary for liaison officers to operate from the flood operations centre if reliable communications are available. The Operations Controller must, however, be prepared to direct required staff to report immediately to the flood operations centre in the event that having them liaise from their supporting headquarters should prove to be ineffective.

Communications

Flood operations centres will need to communicate with both response and supporting agencies. Wherever possible, communications facilities should include dedicated operational links at least between the operations centre and the response agencies. At the local level such links will probably be by radio and the Operations Controller should be prepared to provide additional radios to response organisations and perhaps to supporting organisations in the event of equipment incompatibility. All organisations should, however, use their own internal radio systems.

Whenever possible, the public switched telephone network should be used to keep radio networks free for urgent operational traffic.

Within each operational communications system at local level there must be public access so assistance can be called for. This will require telephones and trained operators who are available throughout the operation to take calls for assistance and pass them to the operations staff for action. These telephone lines and numbers should be separate from the normal operations centre lines and numbers, or operational communications are likely to be interrupted. A simple convention is to maintain silent numbers for operational use.

Facilities will be required for public access operators. Whenever possible, these should be in a room separate from the flood response operations centre itself.

Location

The main requirements for a flood response operations centre are that it:

- is flood-free,

- has at least one flood-free access and egress route,

- has suitable catering and welfare facilities, and

- is suitable as a communications site.

Resource Directories

The identification and location of resources which could be required during a flood operation are essential for a successful operation. Operations Controllers and supporting agency managers at all levels must maintain resource directories, which must contain 24-hour contact information. These directories should be updated regularly, and before each flood season where such seasons exist.

Functional Service Coordinators and Subcommittees

A proven method for a flood Operations Controller to obtain resources not available through his or her own agency is through functional service coordinators or subcommittees.

If the nature of the support likely to be required is relatively simple and will be provided by a single department or organisation, a functional service coordinator will normally suffice. However, if the support needed is likely to be complicated, or drawn from several departments or organisations, a functional service subcommittee may be more appropriate to ensure technical advice is available and all relevant departments or organisations are directly represented. In such cases, the lead or major agency should provide the coordinator for the function.

Functional service subcommittees are formed from agencies with like interests or roles and are tasked with providing support to flood operations. An example is provision of advice and equipment for restoring public utilities and facilities through an engineering functional service subcommittee. The subcommittee becomes operational on the request of the Operations Controller and provides resources and advice as requested.

Functional service subcommittees could encompass a range of functional areas including:

- engineering,

- essential services,

- transport, and

- supply.

Each subcommittee should appoint a coordinator and should consist of appropriate member agencies. They must be an integral part of the emergency management structure.

Engineering

Engineering support can be a major requirement during flood response operations. It will be the Operations Controller's responsibility to ensure that any engineering functional service subcommittee is aware of the possible range of requirements so they may be included in the relevant supporting plan. Support could range from advice about potential actions to the provision of major engineering equipment. It will often involve maintenance of essential services.

Engineering Advice. Engineering advice can be required at short notice during flood response operations, particularly concerning the state of levees and other flood mitigation structures and on expedient engineering work such as the shoring up of levees or the installation of temporary flood mitigation devices (including barriers).

Levees. Whenever there is a flood warning for a community protected by levees, the Operations Controller should arrange for the integrity of the levees to be checked and their heights confirmed. It may be necessary for expedient engineering works to be undertaken at short notice to increase levee height or strength. Out-of-area resources may be required for this purpose.

There is often a possibility that illegal or unlicensed levees have been constructed in such a way as to increase the flood threat to a community. The Operations Controller may need to institute a reconnaissance of the area affected by the flood and it may be necessary to arrange destruction of such levees.

Once floodwaters have arrived, the Operations Controller needs to ensure regular reconnaissance is conducted to maintain the integrity of levees and other structures. If a problem is suspected, technical expertise will be required quickly to determine the appropriate remedial action.

In the case of temporary barriers there are important logistical and deployment factors to consider in the response (for further detail see Chapter 7 of this manual). Permanent barriers require ongoing management which has implications for planning.

Essential Services

The Operations Controller needs to ensure providers of essential services are kept advised of the flood situation. Essential service providers must keep the Operations Controller abreast of their status and ongoing ability to provide those services. The Operations Controller must also take whatever action is necessary to assist the service providers to safely maintain those services for as long as possible. In the event that the services are interrupted the Operations Controller may be required to make alternative arrangements for their provision.

Electricity. Many services (including water supply, sewerage and telephone communications) rely on electricity to operate, and the removal of supply can have significant ramifications. The Operations Controller needs to be aware of these interdependencies. In some cases, restoration of power will be sufficiently important to warrant the provision of an emergency supply to selected agencies. In such cases priorities will need to be established at the highest level. Flood-affected buildings can be inherently dangerous where electricity is concerned and operational teams need to be briefed about potential dangers before entering affected areas.

Water. One of the biggest problems during a significant flood can be obtaining a supply of clean water, as there is the danger of flood-affected storage areas being polluted. Liaison must be established with the local health and water authorities early in the operation and maintained throughout. The Operations Controller should be prepared to arrange for an alternate supply if local supplies are polluted.

Sewerage. Effluent systems are susceptible to floods. Rising water tables, flooded treatment ponds and plant, broken pipes and lack of electricity can cause problems. The Operations Controller must be kept informed of the health risks and there may be a need for temporary facilities to be provided, or in extreme cases for the affected community to be evacuated to avoid outbreaks of disease.

Medical

Early attention must be paid to the viability of medical facilities located in an area at risk of flooding. They must either be protected from flooding or closed and the occupants evacuated.

As response agency personnel are well trained and equipped for the situation, it can be expected that few casualties will result amongst them. Medical issues (including injuries) will often arise among flood victims, however, and are likely to centre around special-needs groups.

If there is to be any evacuation of special-needs groups, the issues which must be considered include arrangements for:

• transferring patients,

- specialist transport requirements for the aged and infirm,

- continuing correct medication for all evacuated patients/residents,

- the accompaniment of all medical evacuees by their personal medical records,

- providing trained emergency nursing staff and carers for any moves and temporary facilities,

- providing specialist diets where required, and

- providing sufficient stocks of inoculations and vaccines for those at risk from disease outbreaks in the aftermath of a flood.

Public Health

Public health can be a major problem in a flood. This risk is most significant for communities which are isolated for any length of time and where evacuees are placed in temporary accommodation.

The Operations Controller must ensure the public health organisations which are providing support to the operation are attending to:

- water supply,

- shelter,

- food supplies,

- toilet and ablution facilities,

- refuse collections and disposal,

- vermin and vector control,

- infectious disease control,

- personal hygiene,

- disposal of dead stock and other animals,

- disinfection, and

- hazardous materials.

As can be seen from the above, considerable capability and expertise are required. Further guidance is contained in the Australian Emergency Manual: **Disaster Medicine**.

Transport

Transport is a key requirement in most flood operations as there is the possibility of having to move large numbers of people or large quantities of goods, often with normal transport facilities disrupted.

Consideration should be given to all means of transport, road, rail, air and water as appropriate. In determining transport requirements the operations controller will need to consider only the broad nature of the task and timings and should then hand over detailed planning to the transport functional subcommittee.

The transport functional subcommittee will normally undertake detailed planning which will involve consideration of:

• category (road, rail, air, water),

• types of vehicles required,

• loads,

• detailed timings,

• selection of routes,

• fuel,

• control, and

• special skills required or possible danger posed to drivers or vehicles.

Road Closures. The authorities responsible for closing and opening roads must ensure the Operations Controller is kept informed. These authorities will normally give priority to protecting their assets and will tend to close roads early and delay their opening to protect surfaces. The Operations Controller should seek an agreement with these authorities for movement of essential personnel and supplies. In the event that restrictions are imposed on civilian traffic it will be essential for positive control to be established over the routes affected, and this will often require police assistance.

There may be a need to establish a facility to gather information about main access routes cut by floodwaters or closed by the responsible authorities. This information should be passed to the travelling public through the media on a regular and pre-determined basis. Any such facility should be separate from the flood operations centre and will need separate public telephone lines to enable enquiries to be answered. The numbers will need to be advised regularly to the public through the media otherwise the flood operations centre is likely to be overwhelmed.

Rail, Air and Water. The same considerations as given to road closures need to be given to rail, water and air transport.

Public Information

Public information during flood response operations is provided for the advice of those affected and for the public generally. The Operations Controller is responsible for ensuring information is disseminated to cover both requirements.

Information to the affected people will include disseminating flood warnings and, in particular, giving notification of the likely effects of a developing flood. It will advise them how to protect themselves and their property. Details are contained in the Australian Emergency Manual **Flood Warning**.

The range of specific issues on which the community at risk should be advised includes, as appropriate to the flood conditions:

- instructions on evacuation,

- road closures,

- public health,

- maintenance of essential services and utilities,

- security of evacuated areas,

- damage minimisation,

- how to obtain assistance,

- immediate welfare and recovery arrangements, and

- means of cleaning up as the flood recedes.

Information on the flood response operation itself must also be provided to the community at large. If this is not forthcoming, operations may be impeded by a heavier load of general enquiries. The best method of providing this information is through regular media releases from the flood operations centre.

To ensure effective management of the flow of information to the public during a flood response operation:

- a media officer should be available to each flood operations centre, or a member of the operations centre staff must be tasked with performing the media function,

- Operations Controllers must be prepared to conduct regular media briefings, preferably at the same time(s) each day,

- if media releases are produced at more than one level (eg regional and state), great care must be taken to avoid contradictory statements. This is best achieved by staggering release times,

- media releases should be authorised by an appropriate officer, normally the Operations Controller, before release,

- the Operations Controller should identify all available means for passing information to the community at risk, and

- the flood operations centre should pass initial recovery information to the community to ensure information is flowing from only one source and is consistent.

A capacity to provide information to people making enquiries is also necessary. If a **call centre** is established, it is preferable that it be in or near the area which is experiencing flooding, because much of the information which people will seek (eg road conditions and closures and the likely areas of inundation) requires a familiarity with the area. Information about such matters is difficult to supply from distant locations and if it is not supplied or is inadequate people will lose faith in the call centre. Having call centre operators who come from the area is the best way of minimising this problem.

Mutual Aid Arrangements and Memoranda of Understanding

Agreements should be developed between agencies at local, regional, State and interstate level for supplying resources. Increasingly such arrangements are contained within Memoranda of Understanding (MOU).

Commonwealth Resources and Local Defence Force Aid

Operations Controllers will need to be aware of the potential for Commonwealth assistance and the procedures for obtaining it. This includes knowledge of the procedures for obtaining support from Defence Force facilities which may be in or near to the area of flood operations. Information on these procedures can be found at the Emergency Management Australia website (www.ema.gov.au).

Material Resources

Deployment
Resources are allocated on a priority basis as determined by the Operations Controller with the advice of the providing agencies. The 'user' agency is responsible for managing the resource. If there is adequate time to transport resources, they should be pre-positioned. This applies particularly to communities which may be cut off from road access including those which may be cut into parts by floods.

Protection

It is a reality that some emergency service headquarters are located on floodplains. These locations should be identified and, if likely to be inundated during a flood, resources should be moved to an alternate location so that they are available for tasking.

Payment for Use

It should be expected that resource providers will seek payment, so a pre-determined system of payment for the individual provider or a generic system needs to be established. This system should be specified in the emergency management arrangements.

CHAPTER 6

Coordinating Flood Warning

In a Nutshell…

The communication of flood warnings is essential to ensure that communities are able to respond to flooding.

Flood warning messages should include:

- *the current flood situation,*

- *what is predicted to happen and when,*

- *what the likely future flood consequences will be and when they will occur,*

- *what people should do to prepare for flooding and to stay safe during flooding, and*

- *where people can seek further information and assistance.*

Flood warnings are typically coordinated to the public through broadcast radio, but in addition doorknocking, fixed and mobile public address systems, sirens, telephone systems, the internet and community-based flood wardens can be used.

The most effective delivery of warnings occurs when a mix of dissemination techniques appropriate to the circumstances of the flood and community is used.

Doorknocking is an effective but resource-intensive method of disseminating warnings. It requires good planning and coordination to be effective. It is especially useful when evacuation is required and to confirm the content of warning messages conveyed by other methods.

Introduction

Once flood predictions have been received and potential flood consequences identified, it is necessary to construct flood warning messages and distribute these to the at-risk community. When they contain appropriate information, reach their audience and are understood, flood warning messages are powerful tools in helping people to manage flood effects in their own interests.

Flood Warning Message Construction

Flood warning messages should ideally be pre-written (that is, drafted before the occurrence of a flood) and edited to suit the conditions of a particular flood as it develops.

A flood warning message needs to communicate to the at-risk population the following information:

- the current flood situation,

- what is predicted to happen and when,

- what the likely future flood consequences will be and when they will occur,

- what people should do to prepare for flooding and to stay safe during flooding, and

- where people can seek further information and assistance.

Messages should aim to create word pictures and where possible use benchmarks based on prior flooding to compare the likely severity and consequences of flooding (eg 'This flood is likely to have similar consequences to the 2001 flood'). They should also include suggestions about appropriate actions for people to take.

Common Safety Advice Messages for Inclusion in Flood Warning Messages

- Never drive, walk, swim or ride through floodwater. This is the main cause of death during floods as water may be deeper or faster flowing than people think and may contain hidden snags and debris, or road surfaces may have been washed away.

- Stack possessions records, stock or equipment on benches and tables, placing electrical items on top.

- Secure objects that are likely to float and cause damage.

- Relocate waste containers, chemicals and poisons well above floor level.

- Keep listening to your local radio station for further information, updates and advice.

- Keep in contact with neighbours.

- Locate and prepare pets for possible evacuation.

- Keep in contact with your neighbours.

- Ensure employees are able to get home before evacuation routes are closed.

- Act early as roads may become congested.

- Move livestock to high ground.

- Collect together medicines, personal and financial documents, mementoes and photographs.

Flood Warning Communication

Flood warning messages need to be communicated to at-risk residents. The following methods are

commonly used in Australia to warn at-risk communities of flooding:

- broadcast media (including radio and television),

- fixed and mobile public address systems,

- sirens, including the Standard Emergency Warning Signal (SEWS),

- telephone (including dial-out systems),

- community-based flood wardens,

- the internet, and

- doorknocking.

Doorknocking to Deliver Warning Messages

Doorknocking must be carefully planned to ensure effective execution.

The key steps in planning for a doorknock are:

- Define the flood-affected areas that are to be doorknocked, using the flood emergency plan and flood intelligence as a guide (and any sectors that may be defined in the plan or otherwise), and determine as far as possible the scale of the task (number of properties to be doorknocked and the time available).

- Determine the time required to warn each sector.

- Determine the number of doorknockers required. Assume that it will take a team up to 5 minutes per property (house, shop, office, institution, industrial establishment, etc) in urban areas to doorknock. For rural areas use a longer time to take into account the greater distances between properties.

- Assume each doorknock team consists of two persons (for safety reasons)

- Use the following formula:

$$\text{Minimum number of doorknock teams} = \frac{\text{Number of dwellings to doorknock} \times \dfrac{\text{Minutes to doorknock one dwelling}}{60}}{\text{Warning time available (in hours)}}$$

For example suppose there are 480 dwellings to doorknock in 2 hours. In this case:

$$\text{Minimum number of doorknock teams} = \frac{480 \times \dfrac{5}{60}}{2} = 20$$

Therefore, at least 40 doorknock personnel would be needed.

Using a map of the affected area, define street segments of about 10-15 premises each. This number provides flexibility in deployment of teams, but note that teams can be assigned one or more street segments.

In each flood-affected area, on the basis of flood intelligence, generally plan to doorknock the lowest-lying areas first and then work up to the higher affected areas.

Determine the total time required to conduct the doorknock operation. This includes the time to assemble the doorknockers, to brief and deploy them, to conduct the actual doorknocking (see above) and to withdraw the doorknockers safely.

Note that evacuees need time after being doorknocked to 'accept' the advice (perhaps after seeking confirmation), to prepare for evacuation (by lifting belongings and deciding what to take with them), and to complete their own evacuation. This must be factored into the determination of the warning time available.

Further information on the construction of warning messages and the communication of warnings can be found in Chapter 5 of the Australian Emergency Manual **Flood Warning**.

Checklists

Checklists to help Operations Controllers with warning activities are at Annex A.

CHAPTER 7

Coordinating Property Protection

In a Nutshell...

Methods of property protection include:

- *Removal or lifting of contents, and*

- *Construction of barriers to prevent the ingress of floodwater.*

Numerous temporary flood mitigation devices, including sandbags, can be used to construct barriers.

The deployment of temporary flood mitigation devices requires careful planning to ensure that appropriate material is available and that adequate resources and time will be available to assemble the barrier.

The building of temporary barriers is suitable only for the protection of property. It should not be used as an alternative to evacuating a community.

Introduction

The protection of private property is an important focus during floods, but it will usually take a lower management priority than the protection of life and the protection of critical infrastructure. In some circumstances the role of agencies in property protection may be limited to the provision of advice to the owners and occupiers of property.

The general aim of property protection is to prevent or minimise property damage. There are two main methods of achieving temporary property protection as a flood is developing. These are:

- removal or lifting of contents. Damage to contents and essential infrastructure and equipment can be reduced or eliminated by either lifting items *in situ* or transporting them to higher areas.

- barrier methods. Temporary barriers constructed from sandbags, earthworks or commercially-available products can be used to prevent water entering buildings or yards.

Removal or Lifting of Contents

The lead agency for flood response can coordinate the protection of property through this method by:

- encouraging at-risk property owners to remove or lift contents through public safety advice contained within warnings and media releases,

- tasking emergency service personnel or personnel from supporting agencies and/or community groups to assist property owners with the lifting and/or transportation of goods, and

- arranging for storage facilities to be established out of flood reach. Such facilities need to be resourced to ensure goods are registered and security at the site is maintained.

Barrier Methods

Numerous methods exist to create temporary barriers to protect property from floodwaters. The original temporary flood mitigation device was the sandbag, which is still widely used today. However, over recent years companies around the world have invented devices that may have utility in providing property protection against floodwaters. Some of these devices are designed to act in the manner of levees by preventing water entering flood-prone areas, while others are designed to act specifically on the building to which the device is attached. Some devices are capable of being utilised in both scenarios.

The Attorney-General's Department provides information about a number of different temporary barrier options that can be used in a flood context.

By contrast to the simplicity of sandbags, modern temporary flood mitigation devices can range from high-tech composite plastic bladders filled with air and/or water through to complex (and sometimes expensive) stainless steel and/or aluminium structures capable of being folded away. The most common factor in their design is the ease of erecting and dismantling the protection so that it is not a permanent part of the visual landscape.

Some examples of possible emergency service applications of temporary flood mitigation devices are:

- protection of infrastructure such as water supplies, sewerage farms, radio stations/masts, electrical sub-stations, telephone exchanges, etc,

- protection of residential caravan parks, groups of residences, or entire business areas,

- to extend the duration of use of low points on evacuation routes, and

- to divert floodwaters away from structures.

The use of temporary flood mitigation devices requires:

- sufficient warning time for the deployment and establishment of the barrier, and

- appropriate logistics support which may include transport and resources to assemble the device to form the barrier.

To forestall inappropriate deployments, cost-benefit analyses may be required before temporary barriers are erected. Because of time constraints, these are difficult to conduct in all but the simplest situations as a flood is rising. They should therefore be undertaken as part of flood planning activities.

The barrier method of flood protection should **not** be used in the following circumstances:

- to restrict major flood flow paths, for example floodways. Restriction can divert the flow of water which may place additional pressure on existing levees or cause unintended damage to other areas,

- on top of existing levees (unless specialist advice indicates that they are capable of accommodating the lateral and vertical pressures associated with the higher level of floodwater, and the additional barrier devices, without compromising levee integrity), and

- on spillways (designed low sections) in levees.

In circumstances where a device is being used to form a barrier to prevent water from entering flood-prone areas, the device should not be used where it is likely that it may be overtopped or fail causing high velocity flooding in the areas intended to be protected. A level of freeboard should also be considered, to give a degree of additional safety. Therefore the appropriate level of protection to be provided will always be at a level below the crest of the barrier.

The deployment of any temporary barrier devices should be carefully planned to ensure that the appropriate amount of material is available, that adequate resources and time will be available to assemble the barrier and that the site at which the barrier is to be assembled is suitable. Sites which are identified as being suitable for the use of temporary flood mitigation devices should be recorded in flood emergency plans. Memoranda of Understanding with suppliers of barriers may be necessary.

The construction of temporary barriers is suitable only for the protection of property and should not be used as an alternative to evacuating a community. Within this constraint and the other constraints noted above, it is not inappropriate for sandbags and sand to be made available to community members for use in blocking off doorways and vents or low points on approved private levees. It is also appropriate to use sandbags to fill short low sections on earthen levees.

Sandbagging

Sandbagging is a common and familiar method of constructing flood barriers. It is slow and labour-intensive and in some instances earthworks can be more effective provided they are properly constructed and bedded in. Mechanical assistance can be used to speed the sandbagging process.

Types of Sandbags. There are many types and sizes of sandbags available, and either jute or plastic bags are suitable. The preferred size is 825 millimetres long by 250 millimetres wide (the dimensions of the standard army or military sandbag). Larger sizes are not recommended as they can be too heavy to handle. A standard sandbag, properly filled, will weigh around 18 kilograms.

Sandbags are normally packed in bales of 1,000, which contain 20 bundles each of 50 bags. A bale of sandbags weighs approximately 220 kilograms, so mechanical handling equipment may be required to unload and perhaps to move them to the filling area.

Filling Sandbags. Filling sandbags by hand is arduous and time consuming, so mechanical filling machines are desirable. The NSW State Emergency Service utilises purpose-built sandbag filling machines and can provide details about them. However, cement trucks can be used as improvised mechanical fillers. If mechanical devices are not available it is wise to construct filling devices. A simple aid can be made from a length of 200 millimetre pipe as shown in Figure 4.

375 mm

Cut handgrip to suit

200 mm plastic sewer pipe
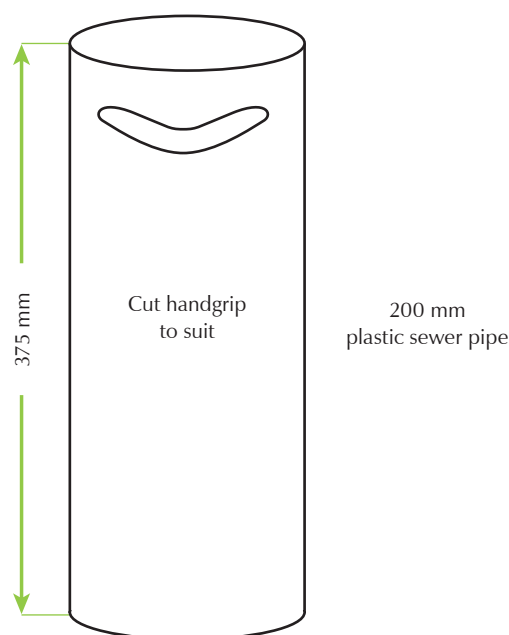
Figure 4: Sandbag Filler

A more sophisticated device can be made by using aluminium or galvanised iron bent to a semi-circular shape, slightly smaller than the mouth of a sandbag to make a chute, ie 200 millimetres, attached to a frame on a 45° angle. The sand is shovelled into the top of the chute, while the fillers hold the mouth of the bag over the bottom of the chute. This method at least doubles the number of bags which can be filled manually (Figure 6).

Sandbags should be turned inside out before filling as this provides additional strength to the seam. They should never be filled more than half to three quarters full, the necks should be tied and the ends folded over.

Barrier Use During a Flood at Charleville, Queensland

In January 2008 a temporary flood mitigation device known as a pallet barrier was deployed from New South Wales to Queensland to protect the town of Charleville from rising floodwaters. The pallet barrier is used by assembling a series of aluminium supports on top of which freight pallets (which are readily available in most towns) are laid and then covered by plastic sheeting.

Once transported to Charleville the barrier was assembled at two sites to fill sections of a partially constructed earthen levee system which was nearing completion at the time of the flood. The sites were 325m and 100m in length respectively. With the use of approximately 20 people and some heavy machinery to assist with lifting and deploying the barrier, the barrier was assembled over a period of some six hours. It is possible to erect the barrier without heavy equipment, however, once the materials have been transported to the site.

Though the floodwaters peaked at a lower height than had been expected, meaning that only a small amount of floodwater needed to be blocked by the constructed barriers, the flood barriers were proved effective to the level of flooding to which they were exposed.

Figure 5: A Constructed Flood Barrier in Charleville, 2008

Sandbag Walls. Sandbag walls should never be constructed with a vertical face, because a wall so laid will possess little strength. They should be laid in a pyramid shape with never less than two rows at the top of the pyramid Figure 7).

Sandbag walls should ideally be keyed into the ground for maximum strength. This is achieved by digging a trench along the line of the wall to the depth of one sandbag and the width of two sandbags (Figure 8).
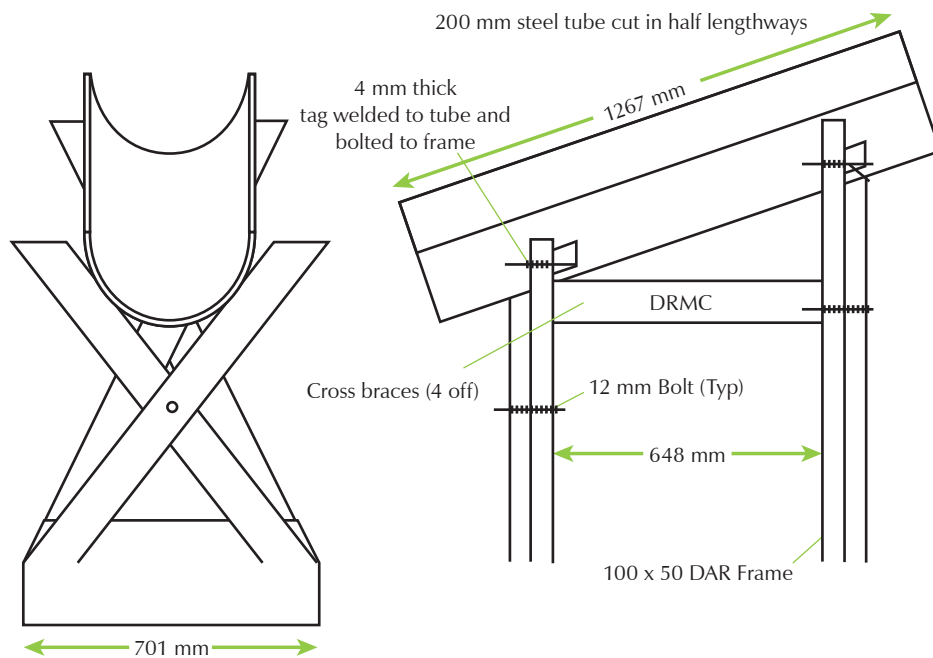
Figure 6: Inclined Shute Sandbag Filler
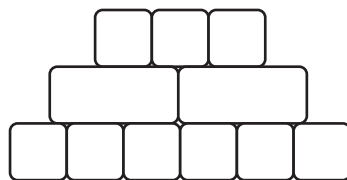
Figure 7: Sandbag Wall Cross-Section, Showing Pyramid Formation
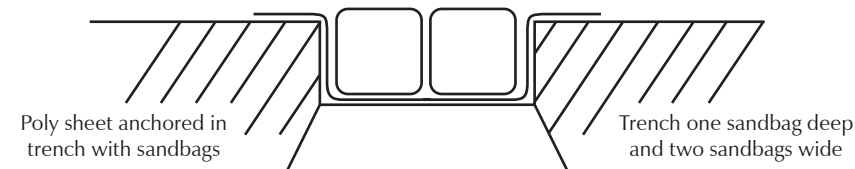
Figure 8: Sandbag Wall Key Trench Cross-Section

Sandbag walls are constructed using alternate rows of 'headers' and 'stretchers'. Headers are sandbags placed end on to the direction of the water with the neck facing away from the water and stretchers are placed side-on with the seam opposite to the direction of the water. The bottom row of sandbags on the surface is always laid using headers, with the neck folded over and facing away from the flow direction of the water (Figure 9).
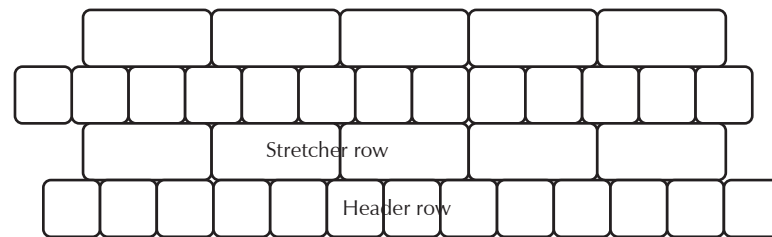
Figure 9: Sandbag Wall Construction Design

Sandbags should always be flattened out after they are laid, using the back of a shovel, a pick-handle or similar implement.

The maximum recommended height for a sandbag wall is 1.5 metres. If there is a requirement for protection greater than the recommended height, a mixture of earth and sandbags is preferable. The diagrams below illustrate the methods of construction (Figure 10).
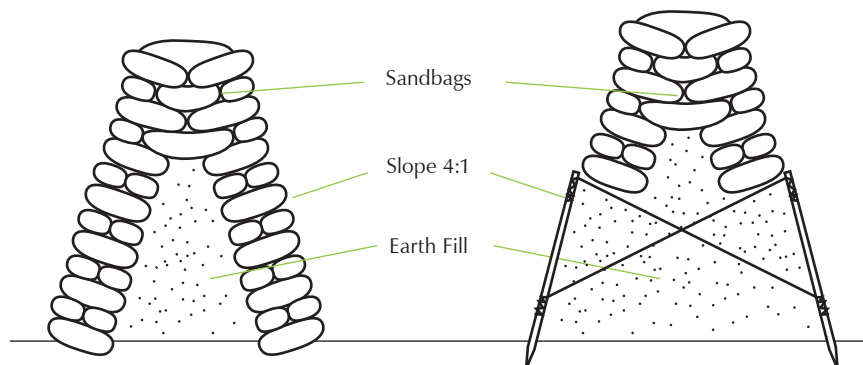
Figure 10: Sandbag Wall Construction Methods

Waterproofing. Sandbag walls are not waterproof, but waterproofing can be achieved using plastic sheeting which is threaded through the layers. Avoid placing any sheeting on the outside wall in the direction of the water (Figure 11).
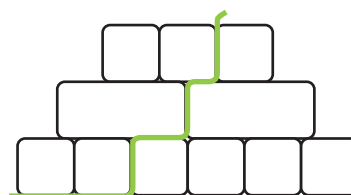
Figure 11: Location of Plastic Waterproofing Sheet

Some Planning Information. All figures presented here are approximate:

- A tamped sandbag will be about 250mm high, requiring four rows above ground and one below for a height of one metre.

- The width of a header will be about 250mm and that of a stretcher 600mm.

- It takes a party of five to fill and lay 60 sandbags per hour provided there is no significant carrying involved.

- It takes approximately 450 sandbags to construct a wall one metre high by 10 metres long. This includes the sandbags for the key trench.

Pumping

When using a barrier method, some floodwater may seep through the barrier or may pond on the 'dry' side due to inability to drain away. Local ponding of storm water can also occur in areas with permanent levees, where drains are closed by floodgates when river rises occur to prevent floodwaters backing up through drains.

If these problems are identified, pumping resources may need to be arranged to pump water away from low-lying areas. Fire services may be able to assist with pumping.

Checklist

A checklist to help Operations Controllers to coordinate property protection activities is at Annex A.

Evacuation

In a Nutshell…

Evacuation planning, to facilitate getting people to a place of safety during floods, is an essential part of planning for floods. If evacuation is likely to be required during a flood response operation, it should have been anticipated in the development of the flood plan. Situations may arise, however, when evacuations must be conducted without the benefit of a plan devised in advance.

Evacuation planning, whether conducted in advance of a flood ('pre-planned') or as a flood is developing ('immediate'), should follow the evacuation cycle of Decision, Warning, Movement, Shelter and Return.

The security of the evacuated area is always a prime concern of evacuees. It must be provided and the community advised.

Introduction

Evacuation may be identified as a requirement during planning. If the scale of the likely evacuation operation is large or its management can be expected to be complex, it may be prudent to prepare a separate evacuation plan. Evacuation can also be dealt with in the body of the emergency management plan or flood emergency plan, or in an annex or a sub-plan.

It may also happen that evacuation is required at short notice in flood situations which have not been identified during planning or when the necessary planning has not been conducted. If these situations are to be handled adequately, there are common guidelines which must be followed. There should be some general planning undertaken in all areas where there could be a need for evacuation for any reason related to flooding.

This chapter covers how to plan for and actually conduct an 'immediate' evacuation.

The Decision to Evacuate

The decision to evacuate may need to be made early during flood operations, under time constraints and with only incomplete information available. How (and by whom) the decision is made will depend upon the availability and nature of the existing evacuation powers, and the implementation of the decision to evacuate will be influenced by the degree to which evacuation can be mandated.

The following may be considered when making the decision to evacuate:

- the likely size of evacuation (ie the number of people evacuating),
- the likely characteristics of flood inundation,

- the time of day,

- the condition of evacuation routes,

- the current and future weather situation,

- the current status of infrastructure such as roads,

- characteristics of the at-risk population (eg age, access to vehicles) and any special needs (eg of culturally and linguistically diverse groups, elderly people and people with disabilities. Arrangements may be necessary to deal with wheelchairs and life-support equipment),

- the time needed to complete evacuations,

- the time available to complete evacuations,

- resources required to complete evacuations,

- resources available to complete evacuations,

- the availability of adequate shelter and welfare,

- the safety of people evacuating and of emergency service personnel (including doorknockers), and

- the need to move and cater for companion animals and pets.

'Voluntary' Versus 'Compulsory' Evacuation, Evacuation Staging and Selective Evacuation

Notwithstanding the fact that in some Australian jurisdictions evacuation cannot by law be compelled, 'voluntary evacuation' has several disadvantages. It can be seen as transferring the decision from authorities to the people at risk, and the latter may regard this as meaning that the authorities are uncertain about the need for evacuation. When this view is formed, people may lose confidence in the authorities and larger numbers of them will refuse to evacuate.

In some circumstances it is appropriate to conduct evacuation in stages, evacuating some areas (eg those likely to be inundated first) before others and/or evacuating the elderly, the infirm and mothers with small children before evacuating other people. Selective evacuation confined to the most vulnerable (eg the occupants of nursing homes) may also be necessary on some occasions.

Evacuation During Flash Flooding

Flash flood environments can be very dangerous and often the choice of emergency management strategies can be difficult since this decision is often a choice between bad options.

Evacuation of existing properties is a suitable strategy only when people are not exposed to greater risks

than they would face by remaining where they are. Due to the limited warning time available and the dangerous nature of flash flooding, in most flash flood catchments where little warning time exists it may be more dangerous for people to evacuate than to shelter in place (ie stay inside their building and move to the highest place). Hazards that evacuees may be exposed to whilst evacuating are:

- flooding of evacuation routes,

- severe weather including strong winds, heavy rainfall, hail and lightning,

- debris, and

- fallen electricity lines.

However, where buildings are located in floodways it is likely that people will be exposed to high hazard conditions in which it will be more dangerous to shelter in place than to evacuate. In these circumstances an evacuation strategy should be adopted.

It may be appropriate for a mixed strategy to be developed, with a shelter-in-place strategy adopted for buildings where evacuation is likely to be more dangerous than sheltering in place and an evacuation strategy where evacuation is less dangerous than sheltering in place. Areas where these strategies apply should be detailed in plans.

In the context of designing future developments it is always preferable for people to be able to evacuate safely rather than becoming potentially trapped within their building and having to shelter in place.

Shelter in Place When Evacuation is Possible

Where sufficient warning time exists to evacuate at-risk residents safely, the option to evacuate should be taken. There are inherent risks with allowing people to shelter in place, as they may become isolated and later inundated by floodwaters.

The isolation of people is not without risk, and hence there is no such thing as a 'safe period of isolation'. Any individual who experiences a life-threatening event (for example a heart attack or a serious accident) while isolated is at significantly greater risk than a person who experiences the same condition but is not in an isolated position. There is a possibility that any one of a range of different emergencies could occur while a site is isolated. These may include fire, medical, rescue or security (crime) emergencies. Individuals may not be able to call for help (eg because of telephone system failure) and stretched emergency service resources may not be able to reach the isolated property in time. Responding emergency services through floodwaters is also dangerous. In addition, isolated properties may become refuges for snakes, spiders and vermin, and debris may threaten the structural integrity of buildings.

It is not correct to assume that members of the at-risk community will act rationally during floods. People who have become trapped within their homes may attempt to flee through floodwater, placing their lives and the lives of others at risk. Such people may also seek to be rescued by emergency services, sometimes after previously refusing to evacuate when advised to do so.

The Planning Process

Whether an evacuation is pre-planned or immediate, the organisation will be essentially the same although, in the latter case, it must be undertaken at speed and some steps may have to be omitted. The following paragraphs provide a guide on how to actually conduct an evacuation.

Initial Actions

Of primary importance is the safety of the people in the affected areas. A number of actions are essential.

Self-evacuation. A decision must be made at the outset as to whether or not evacuees will be permitted to use their own vehicles. Self-evacuation is harder to control than an evacuation for which all transport is provided but it is economical in terms of outside transport resources which, in any case, may not be available in time. In addition it allows people freedom of independence while they are away from home and helps to take the pressure off accommodation resources.

Experience has shown that some evacuees will go their own way if they have transport, and not attend evacuation centres. It should also be remembered that some transport will always be required for those without their own vehicles and to cater for breakdowns or accidents.

Mass Transportation. If some or all of the evacuees have to be moved out of a danger area by mass transport means such as buses or trains, it will be necessary to identify pick-up and assembly areas. Assembly areas may be needed both within and outside the danger area. Any assembly area will ideally be under cover from the elements although, in the worst case, a large open area may have to suffice.

Doorknocking. Once evacuation centres have been identified, it is possible to begin moving people. The best means of initiating movement is by doorknocking, although emergency vehicle sirens and loudspeaker systems can be used. Sirens by themselves (that is, without accompanying verbal messages or education as to their meaning), are usually ineffective in motivating evacuation.

Because of the anxiety and confusion people will be experiencing, emergency services personnel must be on hand to advise and guide evacuees and keep people calm. They must also provide control at assembly centres.

Police Assistance: Invariably, there will be those who will refuse to leave, so areas which have been evacuated must be checked. It is wise to arrange for police assistance to be on hand for this purpose.

Evacuation Centres

Evacuation centres may need to be established to meet the welfare needs of evacuees. The main requirements are that the facilities should:

• provide shelter from the elements,

• have toilet facilities,

• have space for parking, and

• be sufficiently large for the number of people evacuated (in the event of a major evacuation several centres may have to be used) and for the functions which need to be performed. Such functions are likely to include:

  • registration,

  • first aid,

  • initial welfare, and

  • information to evacuees on such things as temporary accommodation.

Schools, registered clubs and other large public buildings are generally suitable.

Responsibilities for the various functions to be performed at evacuation centres should be detailed in emergency plans.

Registration

Evacuees must be registered at evacuation or registration centres (or hospitals in the case of casualties). Normally in Australia registration is undertaken using the National Registration and Inquiry System (NRIS)

The Police are responsible for registration in most states, but whichever agency has the task it will normally need help. If registration is not accomplished quickly, evacuees will drift away. There is a standard national format for registering evacuees which is held by the Police in most states. However, if it is not available, details which should be recorded are:

• surname and initials,

• date of birth,

• home address,

- destination,

- contact phone number, and

- permission to release information.

An inquiry line should be established as soon as practicable. It is important to forward registration details as quickly as possible.

Security of the Evacuated Area

People will be reluctant to evacuate unless they can be assured their homes and possessions will be safe in their absence. Arrangements must therefore be made to ensure property is kept secure. It is important to advise evacuees that the appropriate steps are being taken in this regard.

Advice to the Public

Whenever a major evacuation occurs, it is important to keep the general public informed. Otherwise emergency service switchboards will quickly become jammed and convergence will occur. On-site controllers should ensure regular situation reports are passed to the flood operations centre from where they can be transmitted to all media outlets. The advice provided should include instructions about which areas to keep away from, the progress of the evacuation, and what is intended to be done in the affected area between the time of the evacuation and the time of the return of evacuees to their homes.

Invariably, some evacuees will escape registration. To avoid fruitless searches, media arrangements should include a request for anyone from the disaster area who has left the area but not been registered to call the Police and provide details.

The Return of Evacuees

The successful conclusion of an evacuation normally depends on the safe return home of those evacuated. Arrangements for return must be made at the time of the evacuation if possible or, failing this, as soon as practicable thereafter. There may be occasions when the slow recession of floodwaters or the degree of damage to buildings and infrastructure means that return may not occur for days or weeks after the evacuation. Considerations regarding the issue of an All Clear and allowing residents to return to their properties include:

- the current flood situation,

- current and predicted weather,

- the time of day,

- the status of infrastructure to support the community,

- the condition of flood mitigation works, and

- public health.

Special Considerations in Relation to the Evacuation of Caravan Parks

Many caravan parks are located in flood-liable areas. Caravans can float and suffer severe structural damage during floods. It is very dangerous for people to stay within caravans or cabins during floods.

When evacuating a caravan park the following must be considered:

- caravan park residents need to be notified of the need to evacuate,

- caravan park managers should coordinate the relocation of moveable vans to high ground,

- additional transport may be required to assist caravan park managers to relocate moveable vans,

- a site needs to be established to accommodate moveable vans. Such a site should have power and amenities which would allow people to continue to live in their caravans if appropriate,

- occupiers of non-moveable vans should be encouraged to:

  - secure their vans by tying them down to prevent flotation,

  - isolate power to their vans, and

  - move to a designated evacuation centre

- the caravan park manager should keep a register of the residents who have evacuated from the caravan park and notify the lead agency when the evacuation of the caravan park has been completed.

Note that there may also be special considerations to take into account in relation to the evacuation of schools, pre-schools, hospitals, aged care facilities, jails and other institutions.

Special Considerations in Relation to the Evacuation of Communities Protected by Levees

Since the performance of a levee cannot be assured after its design height or design specifications are exceeded, the design or design specifications should be used as the trigger for evacuation. **Note that this height will often be lower than the crest height of the levee.** This height should be recorded in flood emergency plans and flood intelligence. 'Freeboard' provided when a levee is constructed has been found (because of compaction and other factors) not to exist at a later date.

An Evacuation Operation in Maitland, New South Wales

On June 8 and 9, 2007, extreme rainfall in the Hunter Valley, 150 kilometres north of Sydney, caused the largest flood on the lower reaches of the Hunter River for 30 years. This flood had the potential to invade the urban centre of Maitland (including the Central Business District, Lorn, South Maitland, Horseshoe Bend and part of East Maitland) as well as large areas of rural land nearby.

Maitland is located alongside the Hunter River and experienced devastating flooding in 1955. A series of levees and flood control structures developed since that flood provide protection to low-lying areas from the impact of high-velocity floodwaters flowing directly from the Hunter River, but severe floods will overtop the levees and most of the area protected will become inundated.

In response to flood warnings issued by the Bureau of Meteorology on June 8, the lead agency for flooding (the NSW State Emergency Service) decided to evacuate the at-risk residents from the areas expected to become inundated or isolated. This amounted to the evacuation of some 4000 people, most of whom lived behind the levees. At the forecast flood height, many dwellings would have experienced over-floor inundation. Others would have been surrounded by floodwaters.

The decision to evacuate was made after considering the likely flood consequences (the flooding of residential and business areas), the time of day (so that as far as possible people could evacuate in daylight), the characteristics of the at-risk population (which included large numbers of elderly people), the time available and the time required to conduct the evacuation, and the resources available to carry it out. The decision was made in consultation with the local government council, the operators of the flood mitigation scheme, other emergency services and welfare agencies.

Warnings were distributed by broadcast radio and by doorknocking at-risk residents. All other emergency services were briefed regarding the evacuation plan. The at-risk area was divided into sectors, with sector commanders coordinating doorknocking within sectors. Doorknocking involved not only SES volunteers, but members of other emergency services including some from interstate, illustrating the multi-agency and labour-intensive nature of flood response operations.

Evacuations were coordinated from a central control centre, with liaison officers present to assist with coordination of supporting agencies. Four evacuation centres were opened to provide for the welfare of evacuees.

After making the decision to evacuate, the SES also assessed the availability of rescue resources to ensure sufficient resources were available if rescues were required due to the failure of people to evacuate.

A post-event survey indicated that 76% of the people at risk evacuated. More than 700 people registered at evacuation centres. Fortunately the flood did not reach the level predicted and the built-up areas of Maitland were not inundated. After the peak flood level had passed and after consideration of the integrity of the levees and the status of essential services, an 'All Clear' was issued. The evacuees returned to their properties in daylight.

Requirements for General Evacuation Planning

As part of general emergency planning, prior evacuation planning must be done so that, if an immediate evacuation becomes necessary, for whatever reason, the emergency services will be well prepared. Chapter 4 of the Australian Emergency Manual **Flood Preparedness** contains evacuation planning considerations.

Additional Information

More details on evacuation management are contained in the Australian Emergency Manual **Evacuation Planning**.

Checklist

A checklist to help Operations Controllers in the event that an evacuation is required during a flood operation is at Annex A.

CHAPTER 9

Coordinating Resupply

In a Nutshell…

Communities and/or properties can become isolated during floods as a consequence of the flooding of roads, bridges and causeways. In some areas heavy rain may be enough to make roads unsuitable for traffic.

When communities and/or properties are anticipated to become isolated, they should be encouraged to stock up on essentials including medications and animal food.

Emergency services should be responsible for the coordination of the transport of resupply items to isolated communities and/or properties.

Principles and Elements of Resupply

When flood predictions indicate that properties and/or communities (including towns) are likely to become isolated, if time permits property owners and/or communities should be advised to stock up on necessities. Residents who are unsuitable for isolated conditions (eg because of their medical conditions) or are not prepared for isolation should be evacuated.

Ordering/Procurement

The Operations Controller will require a system to provide control over items which may be supplied in emergency situations. This control can be achieved by developing lists of authorised items and/or by establishing local community vetting committees. Local government will normally be responsible for vetting committees. In the case of isolated properties or travellers in an emergency, there can be a need for resupply using standard packs for which there is usually no charge. More commonly, resupply of isolated properties will be undertaken by restocking from normal suppliers at cost to the occupants but with the emergency transport provided free of charge.

Resupply of isolated communities will normally be coordinated by local government by arranging orders from normal wholesale suppliers for delivery to local retail outlets. However, the Operations Controller will often need to coordinate scarce transport resources.

Coordination

Suppliers will need to deliver resupply items to a designated loading point. This is the point from which resupply items will be transported to isolated communities. Loading points should be established in communities close to isolated areas, but also close enough to normal suppliers to allow easy delivery to them. The choice of loading point location will also depend upon the chosen method of resupply. Suppliers need to be notified of the appropriate loading point to deliver resupply items to.

The most appropriate method of transporting resupply items must be determined. Methods of transport available may include aircraft, train, flood rescue boat or high clearance vehicle.

Points from which resupply items are distributed within isolated communities are referred to as distribution points. Store and property owners should be notified of these points so that resupply items can be collected.

Priorities for resupply should be determined and should be detailed in flood emergency plans. Generally essential services should be given the highest priority.

To ensure resupply is undertaken effectively, a schedule for resupply should be established. Unless the delivery of a small number of items is urgent, transport resources should be utilised to their maximum capability within the contexts of resupply demand.

In addition to the resupply of necessities it may be necessary for flood lead agencies to assist with the transport of mail to isolated properties and/or communities.

Checklist

A checklist to help Operations Controllers to coordinate resupply activities is at Annex A.

Coordinating Flood Rescue

In a Nutshell…

The aim of flood rescue operations is to move people from harm or potential harm to safety. Often, people who need to be rescued have failed to evacuate at an earlier stage of the flood.

Where large-scale evacuation operations are being undertaken or are anticipated, Operations Controllers should ensure arrangements are activated for the coordination of large-scale flood rescue and that sufficient resources are available.

Operations Controllers may need to coordinate reconnaissance to identify people requiring rescue.

It is essential that reliable communications are available between rescue teams and between those teams and the rescue coordinator.

Drop-off points need to be established to ensure adequate welfare is provided to those who have been rescued.

Introduction

Although flood rescue is a task typically performed by specialised, trained and equipped emergency service personnel, the frequency and scale of rescue operations is usually not large. However, when flooding affects large urban areas and many people have failed to evacuate or have become trapped by floodwaters, the demand for flood rescue can be high, leading to the requirement for the coordination of large-scale flood rescue operations. A recent example of the need for such flood rescue operations was the flooding of New Orleans in 2005 after Hurricane *Katrina*.

This chapter deals with the coordination of large-scale flood rescue and outlines the general principles which are involved in the coordination of such operations.

Principles

The aim of flood rescue operations is to move people from harm or potential harm to safety.

Flood rescue operations require coordination and need to be undertaken by trained and equipped personnel.

Where large-scale evacuations are anticipated or are being undertaken, Operations Controllers should ensure that arrangements are activated for the coordination of large-scale flood rescue and that sufficient resources are available to undertake rescues if required. The assessment of rescue resources required should consider the:

• time of day,

- likely weather conditions, and

- likely size of population affected and its compositional characteristics.

Operational planning for flood rescue should identify where low flood islands may develop. These are areas where evacuation routes for people to reach safety may close early. In such situations people may become trapped and later suffer inundation and require rescue.

High flood islands should also be identified. These are areas where the evacuation route for people to reach safety also floods early but at least some land within the area is located above the level of the PMF. These flood-free areas may be used as shelters of last resort for residents provided that appropriate infrastructure and welfare services are available. People may also require rescue from these areas.

Operations Controllers need to be able to identify and task trained and equipped flood rescue units. The system for the accreditation and activation of units is likely to differ between states.

A method of requesting emergency assistance must be available to the community at risk so community members can notify flood response agencies of the need for a flood rescue to be performed. However, during severe flooding the potential exists for power and telecommunications to fail, hence limiting the ability for people to call for rescue. This makes it very difficult for flood response agencies to identify those that may require rescue.

Operations Controllers may coordinate reconnaissance through the use of flood rescue boats, aircraft and observers on flood-free land to identify people requiring rescue.

Methods and Arrangements

Flood rescue can be performed using numerous techniques. These include:

- **reach**, or trying to reach the victim from shore by extending a pole ladder or piece of inflated fire hose. Since the rescuer is not in the water, the risk to him/her is obviously low.

- **throw**, or throwing a flotation device to the victim. This typically involves the use of a throw bag attached to a rope.

- **row**, using a boat, other water craft or 4WD to get to the victim.

- **go**, in which the rescuer enters the water to rescue the victim. Since some would-be rescuers drown attempting to rescue people, this option is considered high risk and should be utilised only after lower-risk options have been exhausted.

- **helicopters**, which may be used to extract victims by landing close to the victim or extracting the victim by winching.

Staging areas from which rescue resources are deployed should be established. These should be appropriately resourced with logistical support such as fuel and catering.

Drop-off points for rescued victims should be established. From these points rescued victims can be transferred to evacuation centres or hospitals. These may be located at the same location as staging areas, but need to be in areas where flood-free access is available to hospitals and evacuation centres. Resources required at drop-off points will include transportation, registration and ambulatory care.

It is essential that reliable communications are available between rescue teams and with the rescue coordinator.

The Avoidance of Large-Scale Rescue Operations

While large-scale rescue operations must occasionally be undertaken, they are fraught with danger and difficulty and are best avoided if at all possible. The most effective ways to avoid the need for such operations are to ensure that:

- land use planning takes into account the requirements for evacuation,

- evacuation planning is undertaken,

- evacuation operations are initiated and completed early enough to obviate the need for rescue activities, and

- people are actively encouraged by the emergency services not to enter floodwaters.

Checklist

A checklist to help the Operations controller coordinate flood rescue activities is at Annex A.

The Transition to Recovery and the Review of Operations

In a Nutshell…

The lead agency should coordinate a post-impact assessment and share the results with other agencies including recovery agencies.

It will often be necessary for emergency services to be involved in the initial stages of recovery operations and to participate as members of recovery coordinating committees.

It may be necessary to engage proactively with the community to provide answers to any questions which may be asked regarding the flood response operation. Especially after floods which have had significant community impacts, such engagement (usually by means of public meetings) is vital.

After-action reviews (debriefs) should be undertaken to ensure lessons are learned and improvements can be made. It is important that recommendations are assigned for action and monitored to ensure they are completed.

Transition to Recovery

Typical post-flood recovery functions will include:

- making buildings safe for return (eg by conducting electrical checks or checks on the structural integrity of buildings),

- return of evacuees,

- establishment of recovery centres to deal with residents seeking assistance,

- cleaning and restoration of homes and businesses,

- restoration of infrastructure,

- the maintenance of public health, and

- mental health support.

Recovery arrangements should be initiated as soon as practicable and should continue concurrently with flood response. This will require close communication between the lead agency and those agencies responsible for recovery.

At the end of the flood response phase there will be a need to make a transition from response to post-flood recovery. The lead agency should facilitate this by providing:

- details of the impact of flooding on the community. This can be best facilitated by the lead agency coordinating a post-impact assessment and sharing the results with recovery agencies, and

- a brief to any recovery committee about the flood response phase and actively contributing as a member of any recovery committee established.

There may be a need for emergency service agencies to be involved in the recovery phase to undertake tasks such as:

- providing information to the community on flood safety,

- washing down of roads,

- washing out of dwellings and other buildings, and

- helping residents to remove damaged goods from their properties.

In a situation where a transition to recovery occurs before evacuees have been instructed it is safe to return to their properties, it will be necessary to communicate with recovery agencies regarding the return of evacuees and the issue of an All Clear message.

Reviews of Operations

It is important for agencies to conduct reviews of their involvement in operations. These are often referred to as after-action reviews or debriefs. Debriefs should be viewed as learning tools and should focus upon the goal of continual improvement. They should focus on what was done, what was done well and what could be improved for the next flood response operation.

Outcomes of debriefs should be recorded and recommendations assigned to appropriate agencies or individuals for action. It is important to monitor actions assigned so that actions are completed. Many recommendations may be useful in improving flood emergency plans.

Debriefs can be conducted at numerous levels involving single or multiple agencies. After a large flood it may be necessary for several debriefs to occur at different levels and involving different stakeholders.

Flood intelligence should be reviewed after each flood and updated as necessary. Efforts should be encouraged during a flood to collect information which would be useful in reviewing flood intelligence records.

It is advisable for flood planners and flood managers to engage proactively with the community after the conclusion of response operations. This allows information to be provided regarding the rationale for operational decisions and creates an opportunity to answer any questions which the public may have.

Engagement can be facilitated through **meetings with individuals** who were affected by the flooding or through public meetings. Members of the community need an opportunity to vent their concerns about the conduct of the flood operation (eg in relation to the content of warning messages they received or the operational decisions that were made on matters such as evacuation or resupply), and they may be able to provide feedback to agencies for later planning. Especially, such meetings should be conducted after floods which have had significant community impacts.

Meetings of this kind also provide platforms to facilitate educational processes. For more detail on these, see Chapter 6 of the Australian Emergency Manual **Flood Preparedness**.

Checklist

A checklist to help the Operations Controller with post-impact assessment is at Annex A.

Operational Checklists

Operations Controllers often find operational checklists useful as aide-memoires during flood response operations. They can be helpful in ensuring that important points are not forgotten in the stresses of an operation. Below are several such checklists for the key functions identified in this manual.

Flood Watch Checklist

The following actions may be necessary on receipt of a flood watch. Actions will vary depending upon likely flood severity:

- Review flood intelligence to assess likely flood consequences

- Monitor weather information

- Review local resources and consider needs for further resources regarding personnel, property protection, flood rescue and air support

- Brief higher and/or lower headquarters

- Notify other emergency services, functional service coordinators and other key stakeholders, and brief them regarding likely consequences and actions required

- Open operations centre if required

- Prepare a flood bulletin for issue to the community, detailing the Flood Watch and public safety advice, and distribute this bulletin to the local media.

- Monitor watercourses and undertake reconnaissance of low-lying areas

- Consider media management strategy

- Consider strategy for liaising with other emergency services

- Consider call taking strategy to manage public enquiries and requests for assistance

- Establish rosters

- Check equipment readiness

- Coordinate the checking of flood mitigation works

- Establish catering arrangements if required

- Develop and issue operational action plan if required

- Develop and issue situation report if required

Flood Warning Checklist

The following actions may be necessary, in addition to those noted in the Flood Watch Checklist, on receipt of a Flood Warning. Actions will vary depending upon likely flood severity:

• Develop an appreciation of the current flood levels and predicted levels. Are floodwaters, rising, peaking or falling?

• Review flood intelligence to develop an understanding of potential flood consequences. Consider:

 • what areas may be at risk of inundation

 • what areas may be at risk of isolation

 • what areas may be at risk of indirect affects as a consequence of power, gas, water, telephone, sewerage, health, transport or emergency service interruption

 • the characteristics of the populations at risk

• Determine what the at-risk community needs to know and do as the flood develops

• Warn the at-risk community by preparing and issuing flood bulletins detailing the current flood situation, flood predictions, what the consequences of predicted levels may be, public safety advice and who to contact for further information or assistance, and distribute these bulletins to local media.

• Consider the use of other warning methods available:

 • doorknocking

 • sirens

 • mobile public address

 • flood wardens

 • the Standard Emergency Warning Signal (SEWS)

Checklist for Severe Weather Warnings and Severe Thunderstorm Warnings for Flash Flooding

The following actions may be necessary on receipt of Severe Weather Warning / Severe Thunderstorm Warning. Actions will vary depending upon likely flood severity:

• Review flood intelligence to assess likely flood consequences

- Review local resources and consider needs for further resources regarding personnel, property protection, flood rescue and air support

- Notify other emergency services, functional service coordinators and other key stakeholders, and brief them regarding likely consequences and actions required

- Open operations centre if required

- Consider preparing a flood bulletin for issue to the community detailing public safety advice and distribute this bulletin to local media.

- Monitor rainfall and water levels

- Undertake reconnaissance of low-lying areas

- Consider media management strategy

- Consider strategy for liaising with other emergency services

- Consider call-taking strategy to manage public enquiries and requests for assistance

- Establish rosters if required

- Check equipment readiness

- Establish catering arrangements if required

- Develop and issue operations action plan if required

- Develop and issue situation report if required

Property Protection Checklist

The risk of inundation to properties may require property protection to be undertaken. The following should be considered:

- Determine the method of property protection required

- Determine the size of the demand for property protection

- Determine the time required and available to conduct property protection

- Identify resources required and resources available

- Identify logistics support:

  - For barrier method

    - sandbags available

- sandbagging machines or concrete trucks

- sand

- flood barrier and associated components

- establish sandbag dumps for members of the public to obtain sandbags

- For removal method

  - identification of transport required

  - storage facilities

  - management of storage facilities

  - security of storage facilities

- Establish means of public information regarding property protection

- Consider requirements for pumping floodwater from low-lying areas

Evacuation Checklist

General Considerations

Define the area to be evacuated and the probable duration of the evacuation operation.

Define needs in terms of:

- numbers of people

- destination

- the amount of time available before inundation occurs or evacuation routes are cut

- the amount of time evacuation will take

- those who should go early

- welfare requirements (and involve the Welfare Service in planning)

Define resources to meet these needs in terms of:

- manpower

- transport

- supplies

- equipment

- communications

- security of the evacuated areas

Check availability, capability and durability of the required resources.

Set priorities for evacuation in terms of areas or special-needs groups.

Decide how the evacuation will be carried out including:

- delivery of warnings

- probable extent of self-evacuation

- assembly areas (if required)

- evacuation centres

- evacuation routes

- transport arrangements

- control and timing of movement

- reception and welfare needs, and

- registration requirements

Promulgate details to all agencies with parts to play in managing the evacuation.

Use the media to pass warnings, advice and information to the public, employing if appropriate the Standard Emergency Warning Signal (SEWS) as a means of attracting attention to the messages that follow.

Discuss the need for a public information/inquiry service with police.

Considerations in Relation to Movement

The very young, the very old and those who cannot evacuate by their own efforts should be evacuated first.

In large-scale operations it is often necessary to evacuate people on a staged, sector-by-sector basis (eg to prevent congestion on evacuation routes, or to ensure that the lowest-lying areas are evacuated first).

When allocating transport resources, keep in mind the priorities for areas or special-needs groups, the need for unexpected medical evacuations and the extent of voluntary or self-evacuation.

Define the routes to be used.

Establish the control structure including:

- assembly areas (if required)

- traffic control

- signposting of the route and safety marking

- identification of control personnel

- check points (if required)

- allocation of responsibilities

- communications

- fuel, vehicle repair and towing arrangements and

- welfare, (particularly first aid) en route

Considerations in Relation to Evacuation Centres

Establish the location and signposting of evacuation centres.

Determine the need for and method of registration.

Cater for welfare needs including accommodation, health, social welfare and clothing.

Establish communications with evacuation centres.

Organise security at evacuation centres.

Considerations in Relation to Post-Evacuation Needs

Provide for handover to:

- the welfare services to look after post-evacuation needs such as resettlement,

- return to the evacuated area and rehabilitation; and

- the engineering services for matters relating to infrastructural restoration.

Other Considerations

Be clear as to who has the authority to order and control an evacuation. This means knowing the extent of police powers and powers of other emergency services.

Make sure evacuees are kept informed of:

- why they are being evacuated,

- what arrangements have been made to ensure their properties are secure while they are away,

- what the reception arrangements are, and

- when they will be able to return to their homes

Keep in mind that people will, if possible, take their pets, domestic and companion animals. In large-scale evacuations it is usually necessary to make separate arrangements for pets because people may not be able to keep their animals (especially large ones) with them throughout their evacuation.

Make arrangements for the return home of the evacuees.

Resupply Checklist

The isolation of properties and/or communities (including towns) may lead to a requirement for resupply. The following should be considered:

When isolation is likely:

- encourage properties and communities, prior to isolation occurring, to stock up on necessities if time permits

- evacuate residents not suited to isolation

When isolation has occurred:

- encourage the owners of isolated properties or storekeepers to place orders with their normal suppliers. Suppliers will be responsible for transporting goods to an established loading point, from which goods will be transported to the isolated property/community by the most suitable means available. Property and store owners will be responsible for payment. Where a property owner cannot afford payment they should be referred to the appropriate welfare agency

- establish loading points from where goods will be transported to from suppliers and then transported to isolated communities.

- develop delivery schedules with appropriate resupply priorities taken into account

- identify most appropriate method of resupply (aircraft, boat or high clearance vehicle)

- identify distribution points within isolated communities.

- consider resources required

- develop sectors as required

Checklist for Large-Scale Flood Rescue

If evacuation has not been possible or has not occurred, there may be a need to conduct large-scale rescue operations. The following should be considered:

- Establish a call-taking facility for requests for rescue from the public

- Carry out reconnaissance of the flood-affected area to identify the individuals who need to be rescued

- Establish resources required

- Determine appropriate rescue methods

- Coordinate arrangements between rescue agencies

- Task accredited rescue resources

- Establish staging areas for rescue resources. These should be resourced with fuel and other required resources for rescue assets

- Establish drop-off points for victims to be transported to hospitals or evacuation centres. Drop-off points should be resourced to provide transportation, registration and ambulatory care for victims.

- Establish evacuation centres to provide welfare for victims

- Establish sectors as required

- Establish means to provide public information regarding rescue

Post-Impact Assessment Checklist

It is necessary to conduct a post-impact assessment to gain an understanding of flood impacts, particularly in relation to people, premises, livestock and infrastructure. The following information should be collected:

- Number of residential properties (and locations)

  - destroyed

  - partially destroyed

  - flooded over floor

  - flooded over ground

- Number of business properties (and locations)

  - flooded over floor

- • flooded over ground
- Number of people deceased
- Number of people injured
- Number of people evacuated (and locations)
- Number of livestock deceased
- Number of livestock injured
- Estimated area of farmland inundated
- Damage to fencing
- Damage to infrastructure (for each item listed below detail the location, characteristics, extent and consequences of the damage)
  - electricity
  - gas
  - water
  - sewerage
  - telecommunications facilities
  - roads
  - railways
  - bridges
  - jails
  - hospitals
  - schools
  - churches
  - libraries
  - art galleries
  - museums
- Isolated areas, their location and number of people affected

Acronyms and Glossary

AEP: Annual Exceedence Probability

The chance, expressed as a percentage, of a flood equalling or exceeding a given size (usually measured as the peak height recorded at a gauge)

ARI: Average Recurrence Interval

The long-term average length of time between floods of a specified size at a given location, expressed in years.

GIS: Geographic Information System

A computerised database for the capture, storage, analysis and display of locationally defined information. Commonly, a GIS portrays a portion of the earth's surface in the form of a map on which information is overlaid.

GPS: Global Positioning System

A satellite-based navigational system used for determining location.

MOU: Memorandum of Understanding

A formal document containing an agreement between organisations about management arrangements.

NRIS: National Registration and Inquiry System

PMF (Probable Maximum Flood)

An estimation of the largest flood that could occur at a particular location.

SEWS: Standard Emergency Warning Signal

References

Australian Emergency Manuals Series:

    Manual 5 **Emergency Risk Management—Applications Guide**

    Manual 9 **Disaster Medicine**

    Manual 11 **Evacuation Planning**

    Manual 19 **Managing the Floodplain**

    Manual 20 **Flood Preparedness**

    Manual 21 **Flood Warning**

    Manual 23 **Emergency Management Planning for Floods Affected by Dams**

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