



**Australian Government**  
**Bureau of Meteorology**

# National Arrangements for Flood Forecasting and Warning

---



© Commonwealth of Australia 2018

This work is copyright. Apart from any use as permitted under the Copyright Act 1968, no part may be reproduced without prior written permission from the Bureau of Meteorology. Requests and inquiries concerning reproduction and rights should be addressed to the Production Manager, Communication Section, Bureau of Meteorology, GPO Box 1289, Melbourne 3001. Information regarding requests for reproduction of material from the Bureau website can be found at [www.bom.gov.au/other/copyright.shtml](http://www.bom.gov.au/other/copyright.shtml)

Published by the Bureau of Meteorology  
Cover Image: Barron Falls, Queensland, March 2018 | Photograph courtesy of Sarah Latham

## Revision history

Date	Version	Description	Author
29 July 2013	V1.0	Draft provided for Executive review	Grant Wilson
19 September 2013	V2.0	Amendments made as a result of Jim Elliott's review	Nicole Pana
29 January 2016	V3.0	Review of jurisdictional chapters	Nicole Pana
21 August 2017	V3.1	Review and Update post restructure	Jim Elliott
4 September 2018	V4.0	Review and approval	Jeff Perkins

## Release signatories

Approval	Name	Signature	Date
V3.0	Jeff Perkins		29 January 2015
V4.0	Jeff Perkins		4 September 2018

## Contact Details

Dasarath Jayasuriya

General Manager Public Safety

Jeff Perkins

National Manager Flood, Tsunami and Storm Surge

## Acknowledgement

The Bureau would like to acknowledge the contributions and effort of the late Mr. Nick Ronan and Mr. Jim Elliott who provided the foundation for this document.

We would also like thank our state, territory and commonwealth stakeholders for their input and review and ongoing support for the Bureau's Flood Forecasting and Warning service.

# Table of Contents

<b>1. INTRODUCTION</b>	<b>1</b>
1.1 PURPOSE OF THE DOCUMENT	1
1.2 TYPES OF FLOODING	2
1.3 SCOPE OF ARRANGEMENTS	3
1.4 DOCUMENT STRUCTURE	4
<b>2. LEGISLATIVE AND ADMINISTRATIVE FRAMEWORK</b>	<b>5</b>
2.1 FLOOD WARNING RESPONSIBILITIES	5
2.1.1 Riverine Flooding	5
2.1.2 Flash Flooding	5
2.1.3 Standard (or Basic) and Supplementary Services	6
2.2 EMERGENCY MANAGEMENT ARRANGEMENTS	6
2.3 FLOOD RISK MANAGEMENT ARRANGEMENTS	7
2.4 WATER DATA COLLECTION AND FLOOD WARNING	7
<b>3. FLOOD WARNING SYSTEM DESIGN</b>	<b>9</b>
3.1 TOTAL FLOOD WARNING SYSTEM	9
3.2 FLOOD PREPAREDNESS AND PLANNING	10
<b>4. FLOOD WARNING ARRANGEMENTS – NATIONAL SUMMARY</b>	<b>12</b>
4.1 NATIONAL ARRANGEMENTS - PRINCIPLES	12
4.2 ROLES OF GOVERNMENT AND COMMUNITY	13
4.3 NATIONAL ARRANGEMENTS – TOTAL FLOOD WARNING SYSTEM OPERATIONS	16
4.3.1 Monitoring and Prediction	16
4.3.2 Interpretation of Flood Predictions	18
4.3.3 Warning Message Construction and Dissemination	19
4.3.4 Communication with Individuals on their Specific Flood Risk	20
4.3.5 Generating Flood Response Behaviour – Community Alerting and Local Action	20
4.3.6 Total Flood Warning System Review	21
4.4 OPERATIONAL COORDINATION ARRANGEMENTS	22
4.4.1 Australian Government Crisis Coordination Centre	22
4.4.2 Commonwealth Level Communications	22
4.4.3 Incident Control Centres	22
4.5 INTERNATIONAL ARRANGEMENTS	22
<b>5. FLOOD WARNING POLICY AND COORDINATION</b>	<b>24</b>
5.1 AUSTRALIA-NEW ZEALAND EMERGENCY MANAGEMENT COMMITTEE	24
5.2 NATIONAL FLOOD RISK REFERENCE GROUP	25
5.3 BUREAU OF METEOROLOGY HAZARD SERVICES FORUM	26
5.4 STATE/TERRITORY COORDINATION - FLOOD WARNING CONSULTATIVE COMMITTEES	26
<b>6. ESTABLISHING NEW AND IMPROVED SYSTEMS</b>	<b>28</b>
6.1 ESTABLISHING RISK BASED PRIORITIES	29
6.4 FLASH FLOOD WARNING SYSTEMS	30
6.5 FUNDING PROGRAMS	30
6.5.1 National Funding Programs	30
6.5.2 State and Territory Funding Programs	31
6.5.3 One-off Funding through Major Initiatives	31
<b>7. APPENDICES</b>	<b>32</b>

APPENDIX 1 – TYPICAL ACTIVITIES TO SUPPORT TFWS ELEMENTS.....	32
APPENDIX 2 – TYPICAL ACTIVITIES UNDERTAKEN BEFORE, DURING AND AFTER THE FLOOD .....	36
APPENDIX 3 – TERMS OF REFERENCE OF THE BUREAU OF METEOROLOGY HAZARD SERVICES FORUM.....	39
APPENDIX 4 – FLOOD WARNING ARRANGEMENTS IN VICTORIA.....	44
APPENDIX 5 – FLOOD WARNING ARRANGEMENTS IN NEW SOUTH WALES AND THE AUSTRALIAN CAPITAL TERRITORY.....	49
APPENDIX 6 – FLOOD WARNING ARRANGEMENTS IN QUEENSLAND.....	54
APPENDIX 7 – FLOOD WARNING ARRANGEMENTS IN THE NORTHERN TERRITORY.....	58
APPENDIX 8 – FLOOD WARNING ARRANGEMENTS IN WESTERN AUSTRALIA .....	62
APPENDIX 9 – FLOOD WARNING ARRANGEMENTS IN SOUTH AUSTRALIA .....	66
APPENDIX 10 – FLOOD WARNING ARRANGEMENTS IN TASMANIA .....	70
APPENDIX 11 – REFERENCES .....	76

# 1. Introduction

Flooding is a significant risk to the safety and amenity of all Australians. The provision of advance warning of flooding provides the opportunity for individuals living or travelling in the area at risk, their families, the communities in which they live and the agencies with responsibilities for ensuring their safety, to make appropriate preparations to mitigate the adverse impacts of the flooding. Advance flood warning benefits farmers and those operating businesses, critical utilities and infrastructure (power, water, roads etc.) directly by providing time to protect their assets and operations. It assists insurance companies by reducing the level of compensation for flood damage and reduces costs to the general taxpayer of funding relief and recovery operations. Effective flood warning is just one of a range of measures that can be applied to reduce the impact of flooding.

## 1.1 Purpose of the Document

The purpose of this document is to provide the Australian public with a summary of how the provision of flood forecasting and warning services is arranged nationally and be a key resource for ongoing community education around Bureau of Meteorology (Bureau) flood services. The document updates an earlier version, in particular by including changes introduced as part of the Intergovernmental Agreement on the Provision of Bureau of Meteorology Hazard Services to the states and territories<sup>1</sup> (the Intergovernmental Agreement). These changes include the decision to purposefully move to more uniform or standardised services across all jurisdictions<sup>2</sup>. This document (including appendices) will describe current practices and arrangements in each jurisdiction. The national arrangements are presented in terms of the roles and responsibilities of each level of government in delivering flood forecasting and warning services to the Australian community, covering both operational responsibilities as well as overall policy coordination and review. The specific arrangements and agency roles that apply in each jurisdiction<sup>3</sup> to deliver on those roles and responsibilities are included as separate appendices.

This document has been prepared by the Bureau of Meteorology as lead national agency with responsibility for flood forecasting and warning and has been circulated widely among key stakeholder agencies at the Commonwealth and other levels of government with a part to play in the current arrangements. It is one of a suite of documents (Figure 1) aimed at improving the clarity and detail of flood warning policy and practice. The three tiers of documents published by the Bureau are:

- National Arrangements for Flood Forecasting and Warning (this document)
- Service Level Specifications (SLS) for each State/Territory that contain details of the services provided in each jurisdiction in terms of the areas served, forecast locations and service levels

---

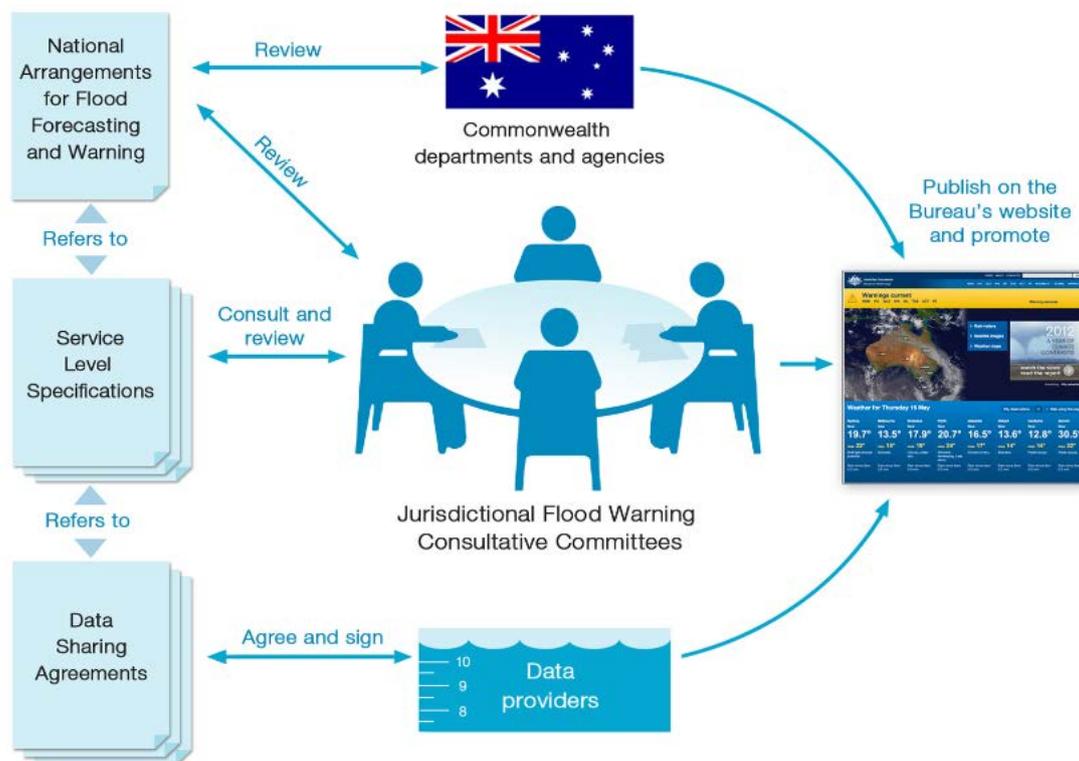
<sup>1</sup>Intergovernmental Agreement: <https://www.coag.gov.au/about-coag/agreements/intergovernmental-agreement-provision-bureau-meteorology-hazard-services>

<sup>2</sup>Further background in Section 5.3 (Bureau of Meteorology Hazard Services Forum) and Appendix 3.

<sup>3</sup>Jurisdiction: refers to all States and the Northern Territory

provided.

- Data Sharing Agreements (DSA) that describe the current arrangements for supplying (near) real-time data to support flood forecasting and warning operations.



**Figure 1: Formalising flood forecasting and warning service levels and arrangements**

## 1.2 Types of Flooding

The definition of flooding adopted in the Intergovernmental Agreement is as was formalised in the *Insurance Contracts Regulations 1985* where 'flood' is defined as:

"The covering of normally dry land by water that has escaped or been released from the normal confines of:

- Any lake or any river, creek or other natural watercourse, whether or not altered or modified; or
- Any reservoir, canal or dam<sup>4</sup>.

Floods in Australia are predominately caused by heavy rainfall, although extreme tides, storm surge, tsunami, snow melt or dam break can also cause flooding. More recently, coastal flooding as a result of sea level rise due to climate change is being considered in planning and land management strategies.

<sup>4</sup> Insurance Contracts Regulations 1985 s29D <https://www.legislation.gov.au/Details/F2015C00353>

This document only focuses on arrangements for warning of flooding as a result of heavy rainfall, which generally falls into the two broad categories, flash floods and riverine floods. National arrangements are in place to provide warnings of flooding due to storm surge and tsunami, with further details available on the Bureau website<sup>5</sup>. Storm surge, particularly when associated with a tropical cyclone, can act to exacerbate the impact of riverine flooding in the coastal zone. Flood forecasting models need to account for this interaction and close coordination between riverine and storm surge operations is important. There is no such causal interconnection between tsunami events and riverine flooding and the tsunami warning system operates quite independently. Release of water resulting from the operations of water storages are only included here to the extent that it coincides with periods of heavy rainfall. Flooding due to dam break is not covered. Warnings of flooding solely due to the release of water from reservoirs or dams are normally the responsibility of the owner of the structure. Arrangements differ across the various jurisdictions and further detail is included in the jurisdictional summaries attached as appendices to this document.

Flash floods are floods of short duration with a relatively high peak discharge in which the time interval between the observable causative event and the flood is less than six hours<sup>6</sup>. Flash floods can occur almost anywhere, and result from a relatively short, intense burst of rainfall, for example during a thunderstorm. During these events, the drainage system may be unable to cope with the downpour and flow frequently occurs outside defined flow paths. Areas with low-capacity drainage systems, whether natural or artificial, are particularly vulnerable to flash flooding that can include overland or sheet flooding where rainfall on impermeable surfaces runs off like a sheet across the area. Although flash floods are generally localised, they pose a significant threat to human life, because of their rapid onset and dangerous flow velocities and depths.

Riverine floods occur six or more hours<sup>7</sup> after heavy rainfall when watercourses do not have the capacity to convey the excess water. They occur in relatively low-lying areas adjacent to streams and rivers. In the flat inland regions of Australia, floods may spread thousands of square kilometres and last several weeks with warning lead times of the order of at least several days, extending to weeks for the longer rivers. In the mountain and coastal regions of Australia, flooding is often less extensive and of shorter duration, with higher flow velocities. Effective flood warnings can normally be provided in these flooding situations with lead times typically ranging from six to twelve hours or longer.

### 1.3 Scope of Arrangements

The arrangements described here focus only on the operation of the present system that prepares and delivers flood warning information to the community at risk from riverine flooding. It also includes

---

<sup>5</sup> Bureau of Meteorology website: <http://www.bom.gov.au/>

<sup>6</sup> Council of Australian Governments (2017), *Intergovernmental Agreement on Provision of Bureau of Meteorology Hazards Service*, Schedule 3

<sup>7</sup> Council of Australian Governments (2017), *Intergovernmental Agreement on Provision of Bureau of Meteorology Hazards Service*, s11.1(13)

arrangements for establishing new and improved services for riverine flood warning including planning, coordination and review activities.

For the system to operate with maximum effect, it is essential that the community be prepared to respond appropriately to the warning information being delivered. This involves those in the floodplain understanding their own personal risk, being aware of how the warning service has been designed to assist in making them safe and knowing what to do when they become aware of the threat of flooding through a warning. Establishing and maintaining this level of preparedness is also a shared responsibility for the community and government agencies but is undertaken within a different framework of arrangements and is not described in any detail in this document.

### **1.4 Document Structure**

The current legislative and administrative framework within which flood warning services are provided will first be described followed by a summary description of the total flood warning system (TFWS). This system includes all the elements considered necessary for an effective flood warning system, with agencies at different levels of government contributing to the various TFWS elements through their responsibilities in the related areas of emergency management, flood risk management and water data collection as described. This will be followed by a national overview of arrangements, covering the role of each level of government, how each level contributes to the various elements of the TFWS and the operational coordination arrangements that apply at national and state levels during floods. Arrangements for national and jurisdictional coordination and service policy guidance and review will be described concluding with arrangements for establishing and funding new and improved services. More detailed description of agency roles in individual jurisdictions are presented as separate appendices to this document.

## 2. Legislative and Administrative Framework

This section presents the main components of the legislative and administrative setting in which flood warning services are provided. This includes legislative and administrative arrangements that apply directly to flood warning as well as arrangements for emergency management, flood risk management and water data collection which influence how state and local government agencies provide their inputs.

### 2.1 Flood Warning Responsibilities

The legislative authority for the Bureau of Meteorology role in flood warning comes from the *Meteorology Act (1955)* wherein one of the functions of the Bureau is to issue “warnings of.....weather conditions likely to give rise to floods.....”. Subsequent Commonwealth Government decisions (in 1987) established the Commonwealth position that flood forecasting and warning be funded on a shared basis with other levels of government and coordinated through consultative committees. Following recommendations from a 2011 review<sup>8</sup> of the Bureau’s capacity to respond to future extreme weather and natural disaster events, the Australian Government, in partnership with the States and Territories, agreed to formalize and standardize service levels provided to emergency services and to agree clear allocation of responsibilities to state and local government for flood management, with defined boundaries on the Bureau’s role (refer Intergovernmental Agreement).

#### 2.1.1 Riverine Flooding

The Intergovernmental Agreement resolved that the Bureau has the responsibility for provision of forecasting and warning services for Riverine Flooding in all States and Territories except for Port Phillip and Westernport catchments and the Lower Murray<sup>9</sup>. Arrangements for the aforementioned catchments will be described later in the document under the arrangements that apply in Victoria and South Australia respectively, although these arrangements are currently under review.. To support the Bureau, the States and Territories will provide the Bureau with relevant flood information (including data) that is in their possession or control and required by the Bureau in order to discharge its responsibilities.

#### 2.1.2 Flash Flooding

In relation to Flash Floods, the parties to the Intergovernmental Agreement further agreed that:

- a) All levels of government will collaborate in preparing the community for the potential of Flash Flooding, which by its nature may not allow sufficient lead time for site specific warnings and forecasts;

---

<sup>8</sup> Review of the Bureau of Meteorology’s capacity to respond to future extreme weather and natural disaster events and to provide seasonal forecasting. Chloe Munro (2011).: <http://www.environment.gov.au/resource/review-bureau-meteorologys-extreme-weather-and-seasonal-forecasting-capacity>

<sup>9</sup> Action to transition forecasting services for these catchments into the Bureau is underway.

- b) Responsibility for Flash Flood warnings and systems lies with the States and Territories in partnership with local government (where appropriate) within their jurisdictions. States and Territories generally determine localities at risk of Flash Flooding from flood studies as part of a formal risk assessment process. The role the Bureau plays in supporting the States and Territories is detailed further in Section 3.2.

### 2.1.3 Standard (or Basic) and Supplementary Services

In order to apply a consistent cost-recovery model to all services delivered to emergency service agencies, hazard related services have been categorized as either Standard (or Basic) Services, which are core services that the Bureau will provide freely in the public interest in accordance with section 6(2) of the *Meteorology Act 1955* (Cth), and Supplementary Services, which the Bureau provides in accordance with Commonwealth Cost Recovery Guidelines.

The role of other agencies in flood forecasting and warning is undertaken as part of their activities in the related fields of emergency management, flood risk management and water resources data collection; all of which are State and Territory responsibilities leading to some differences in arrangements between jurisdictions. The connection between activities in these fields and flood forecasting and warning will be discussed in the following sections. More specific detail can be found in relevant State/Territory disaster and emergency management arrangements and legislation, as well as arrangements for related activities in flood risk management. The particular arrangements that apply in each jurisdiction are described in Appendices 4-10 covering each individual jurisdiction.

## 2.2 Emergency Management Arrangements

Under Australia's constitutional arrangements, State and Territory governments have responsibility for emergency management within their jurisdictions, but work in partnership with the Commonwealth and Local Government, business and industry, and the community. The States and Territories control most of the functions essential for effective emergency management, ensuring the relevant legislative and regulatory arrangements are in place that relate to the operation of the agencies that provide emergency services to the community.

Under cooperative arrangements with the States and Territories, the Commonwealth Government provides support and assistance to the States and Territories when requested, including financial assistance and support for capacity development and research.

The roles and responsibilities of different levels of government for emergency management, along with those for individuals, business and other parties, are set out in the Australian Emergency Management Arrangements<sup>10</sup> (AIDR, 2014). Each jurisdiction meets their requirements through legislation and related arrangements that have been established in particular for ensuring effective response to warnings.

---

<sup>10</sup> Australian Emergency Management Arrangements (AIDR 2014,) <https://knowledge.aidr.org.au/resources/handbook-9-australian-emergency-management-arrangements/>

## 2.3 Flood Risk Management Arrangements

All levels of government have some responsibility for flood risk management. Although arrangements vary between jurisdictions, the responsibility is primarily with State/Territory and local flood management authorities, working within State/Territory and Local Government policies and legislation. The role of these authorities normally includes the design and implementation of flood mitigation strategies which can include the facilitation and support of flood warning systems. Local authorities in particular can be involved with detailed flood studies, flood inundation mapping and modelling, and flood awareness and education activities that are especially relevant to flood warning. Each jurisdiction has established independent arrangements for meeting their responsibilities for flood risk management and work within these arrangements to provide assistance with the development and operation of flood warning systems.

## 2.4 Water Data Collection and Flood Warning

State and Territory governments are responsible for the assessment and management of water resources in their jurisdiction and undertake the majority of streamflow measurement and monitoring of the nation's rivers for this purpose. As the national meteorological agency, the Bureau of Meteorology has responsibility under the *Meteorology Act (1955)* for climate monitoring and so operates and maintains the major portion of the nation's rainfall (and other climate/weather) monitoring networks. In addition, under the *Water Act (2007)*, the Bureau has specific powers and obligations in relation to compiling and disseminating water information. This includes the requirement that the Bureau be provided with a wide range of water information, including that required for flood warning purposes.

The Bureau operates and maintains some rainfall and river monitoring stations for the purpose of flood warning. Data from other agency streamflow measurement networks at State, Local and Regional level have always been a necessary input to the national flood forecasting and warning system operation, especially to assist the Bureau in its role in flood prediction. Figure 2 shows the spatial coverage and ownership of rainfall and river level gauges across Australia.

The Intergovernmental Agreement includes agreement that the States and Territories will provide the Bureau with relevant flood information that is in their possession or control in order to discharge its responsibilities. Strong cooperative relationships have been developed among the agencies concerned and the Bureau of Meteorology. The detail of these arrangements varies between jurisdictions and is described in separate Data Sharing Agreements established for each jurisdiction between the Bureau and agencies providing data.

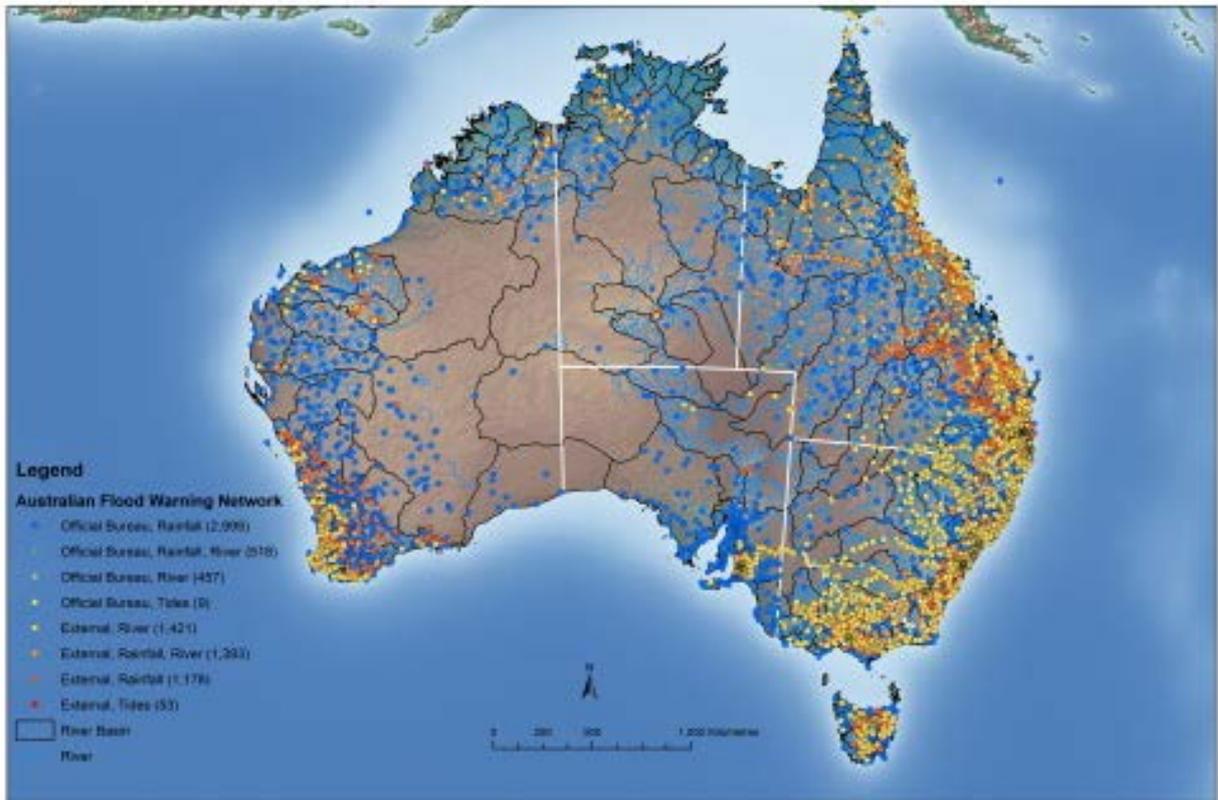


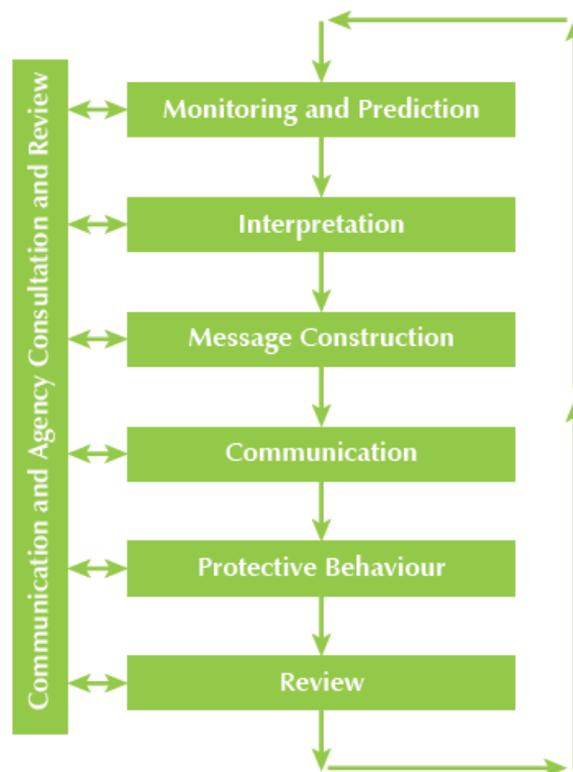
Figure 2: Rainfall and River stations available to the Bureau for flood warning services showing ownership (as at January 2017)

### 3. Flood Warning System Design

The goal of flood warning is to help flood management agencies and the members of flood prone communities to understand the nature of developing floods so that they can take action to mitigate their effects. The purpose of a flood warning is to provide advice on impending flooding, so people can take action to minimise its negative impacts. This will involve some people taking action on their own behalf and others doing so as part of agency responsibilities. A flood warning system is a set of connected activities (or elements) designed to operate together to achieve this purpose. Flood warning systems in Australia are designed using the concept of the Total Flood Warning System (TFWS).

#### 3.1 Total Flood Warning System

This concept (illustrated in Figure 3) has been developed to describe the full range of elements that must be developed if flood warning services are to be applied effectively.



**Figure 3: The components of the Total Flood Warning System (Australian Emergency Manual Series, Manual 21 Flood Warning, AIDR, 2009)**

At its simplest, an effective flood warning service can be defined as having six components (AIDR, 2009):

**Monitoring and Prediction:** Detecting environmental conditions that lead to flooding, and predicting river levels during the flood;

**Interpretation:** Identifying in advance the impacts of the predicted flood levels on communities at risk;

**Message Construction:** Devising the content of the message which will warn people of impending flooding;

**Communication:** Disseminating warning information in a timely fashion to people and organisations likely to be affected by the flood;

**Protective Behaviour:** Generating appropriate and timely actions and behaviours from the agencies involved and from the threatened community; and

**Review:** Examining the various aspects of the system with a view to improving its performance.

For a flood warning system to work effectively, these components must all be present, and they must be integrated rather than operating in isolation from each other.

The activities involved within each of these elements are shared among agencies at all levels of government. The integration of the activities such that the total system operates effectively and efficiently can present significant coordination issues. A more detailed coverage of the design of the TFWS is found in Manual 21 Flood Warning<sup>11</sup> (AIDR, 2009).

### 3.2 Flood Preparedness and Planning

Flood warning systems are designed to operate for the period immediately before and during flood events. To be fully effective in their operation, it is important that the target community is prepared to receive and act on the warnings provided. This requires that they be made aware of their own risk, how the warning system has been designed to provide the opportunity to mitigate the risk they face from the flood, and what to do when they learn of the imminent threat of flooding through a flood warning.

In addition to understanding arrangements for the establishment and operation of the Total Flood Warning System, an important part of the picture regarding flood warning arrangements is to ensure the community is aware of:

- Whether or not they are at risk from flooding.
- If there is a flood warning system covering the area where they live and work or may be travelling.
- What they need to do to be prepared.
- How the flood warning system is maintained and kept in a state of readiness.
- How they will be alerted.
- What they should do when they learn of an imminent threat from flooding.

---

<sup>11</sup> Manual 21 *Flood Warning* (AIDR, 2009) <https://knowledge.aidr.org.au/media/1964/manual-21-flood-warning.pdf>

Putting the necessary arrangements in place for ensuring this understanding is also a shared responsibility for the community and relevant government agencies and is part of what is normally referred to as flood preparedness. While it is not intended to cover this activity in detail in this document, it is important that the arrangements for the above elements of flood preparedness are kept in view as part of any comprehensive picture of flood warning arrangements. The reader is referred to Manual 20 Flood Preparedness<sup>12</sup> (AIDR, 2009) for a more comprehensive coverage.

It is also important that flood warning systems be kept in a state of readiness so that they operate effectively with the little advance notice that is normally available, and that investments made in improving the existing system or implementing new systems between floods is planned effectively. System review and planning new investments in flood warning systems will be covered in later sections.

---

<sup>12</sup> Manual 20 *Flood Preparedness* (AIDR, 2009) <https://knowledge.aidr.org.au/media/1963/manual-20-flood-preparedness.pdf>

## 4. Flood Warning Arrangements – National Summary

This section first lists the principles that have guided the establishment of current national arrangements, which have evolved from earlier Commonwealth Government decisions and subsequent consultation processes and more recently from the Intergovernmental Agreement. The arrangements focus mainly on roles and responsibilities for both the operational component as well as the strategic planning and development of the service. Linkages with flood preparedness and planning activities are made but the specific roles and responsibilities for these activities are not included. A broad overview of the role of each level of government and the community will be presented, followed by a more detailed description of the various roles in the operation of the TFWS during flood episodes. Typical activities of each level of government in both TFWS operations and during the periods leading up to and following flooding have been included as separate appendices.

### 4.1 National Arrangements - Principles

The principles behind the current arrangements are that:

- Flood warning in Australia involves agencies from Commonwealth, State/Territory and Local Government, regional authorities, and organisations that contribute to the data observing network.
- Flood warning services are best provided through a cooperative approach involving all these parties. It must also be recognised that all these parties make up the flood warning service whether they be an agency, private entity or individual and they all have some degree of service ownership.
- Flood warning arrangements need to recognise the whole-of-nation resilience based approach to disaster management adopted in the National Strategy for Disaster Resilience<sup>13</sup> as a shared responsibility between governments, communities, businesses and individuals.
- Effective flood warning services are provided where beneficiaries have a direct involvement in the provision of the service and contribute to its cost.
- Effective flood warning services rely on utilising the existing strengths of partner agencies, private entities and communities.
- Free near real-time access to rainfall, stream level and stream flow observations are to be provided to the Australian community.
- National arrangements should be designed so as to move the current arrangements and practices

---

<sup>13</sup> To view the National Strategy for Disaster Resilience:  
<https://www.ag.gov.au/EmergencyManagement/Documents/NationalStrategyforDisasterResilience.PDF>

that apply in each jurisdiction toward national best practice<sup>14</sup>.

- National arrangements should recognise that flood preparedness activities (outside flood episodes) designed to ensure the target community is fully ready and able to respond are a crucial part of the overall set of arrangements.
- Because of the very localised nature of flash flooding, the prime responsibility for flash flood warning lies with States and Territories working in partnership with local government (where appropriate) within their jurisdictions.

## 4.2 Roles of Government and Community

The role played by each level of government in flood forecasting and warning is generally consistent within each jurisdiction and is described in the following. A more detailed breakdown of how each level of government and the community contributes to the different elements of the TFWS is given in Appendix 1.

### **Commonwealth Government Role:**

- The Bureau delivers flood forecasting services through a National Operations Centre in Melbourne and forecasting centres in each State and Territory (except the Australian Capital Territory). These activities utilise data networks supplied under cooperative arrangements with State, Territory and Local Government agencies. The Bureau disseminates flood warnings to other agencies and the community through the media as well as its website, which also displays all data collected and used for flood forecasting and warning.
- Emergency Management Australia (Department of Home Affairs) is home to the Australian Government Crisis Coordination Centre (AGCCC)
  - To connect relevant Australian Government, State and Territory agencies and consolidate Australian Government actions during complex national crises, and
  - To develop a single, timely and consistent picture or understanding of a crisis, its implications and the national capacity to respond.
- The Bureau provides a component of the real-time data collection network used for flood prediction.
- The Bureau provides a range of supplementary services to support State, Territory and Local Government agencies in the planning, establishment and operation of riverine flood warning

---

<sup>14</sup> For a guide on best practice refer to Manual 21 *Flood Warning* (AIDR, 2009): <https://knowledge.aidr.org.au/media/1964/manual-21-flood-warning.pdf> and Handbook 7 (AIDR 2017) *Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*. <https://knowledge.aidr.org.au/resources/handbook-7-managing-the-floodplain/>

systems.

- The Bureau supports State, Territory and Local Government activities in flash flood warning by:
  - Continuing to work actively with local governments to support the development of such systems and procedures, in particular through the provision of advice on the design, implementation and management of flash flood systems through the Flash Flood Advisory Resource (FLARE);
  - Communicating supplementary information (to its standard warning products), such as radar and rainfall forecasts, directly through the emergency services mechanism established in each State and Territory;
  - Republishing any State, Territory or local government generated flash flooding information on its website if a mechanism for doing so is agreed and arranged prior to the operational event; and
  - Provision of forecasts and warnings for severe weather conditions and potential heavy rainfall conducive to flash flooding and to carry out applied research and development to improve the provision of severe weather information.

### **State/Territory Government Role:**

- Provide a component of the real-time data collection network used for flood prediction and information.
- Interpret Bureau flood predictions into more localised impacts and prepare and disseminate locally tailored information based on these predictions to the community at risk.
- Lead responsibility for emergency management and response activities. This includes flood preparedness and the preparation and operation of flood response plans (including evacuation) in association with Regional and Local Government groups in accordance with jurisdictional emergency management and flood risk management arrangements.
- Development of Flood Classification Levels (see later) in conjunction with local government and the Bureau.
- Support the planning, implementation and operation of flood warning systems as part of jurisdictional flood risk management plans and strategies.
- Develop and implement community and industry flood awareness programs down to the local level.
- Share the responsibility for Flash Flood warnings and systems with Local Government.

### **Regional Agency<sup>15</sup> Level Role:**

- Provide a component of the real-time data collection network used for flood prediction and information.
- Contribute expertise to assist with the interpretation of Bureau flood predictions into local impacts and with the preparation and dissemination of local warning information.
- Support the planning, implementation and operation of flood warning systems as part of jurisdictional flood risk management plans and strategies.

### **Local Government Role:**

- Contribute to the real-time flood warning data network either directly or through local cooperative programs with other agencies.
- Key role in emergency management and response, including flood preparedness activities and response planning.
- Lead and manage the preparation of flood studies and communicate their outcomes to at-risk communities and businesses.
- Assist with the interpretation of flood predictions into local impacts and with local warning dissemination in accordance with jurisdictional emergency management arrangements.
- Promote local flood awareness through locally developed programs and in coordination with programs of other levels of government.
- Implement and operate flash flood warning systems in collaboration with State and Territory agencies and with the support of the Bureau through severe weather services and research.

### **Community Role**

- Individuals and business carry a share of the responsibility for building a disaster resilient community.
- Community members need to be aware of their particular flood risk and be prepared and accept guidance by relevant authorities in responding effectively to the flood warning information.
- The community has a role to inform itself and contribute to the planning and implementation of flood response measures.

---

<sup>15</sup> This includes agencies with a jurisdiction extending across part of a State such as Catchment Management Authorities.

## 4.3 National Arrangements – Total Flood Warning System Operations

### 4.3.1 Monitoring and Prediction

This role is performed nationally by the Bureau of Meteorology operating through its National Operations Centre in Melbourne and operational forecasting centres in each capital city (except Canberra)<sup>16</sup>. These centres operate when required on a 24/7 basis and are staffed with specialist hydrologists and meteorologists involved in monitoring the state of rivers and their catchments and assessing the likely impact of any forecast rainfall in terms of whether or not flooding is likely in any particular part of the country. On the basis of this assessment, a Flood Watch can be issued for any catchment with a potential for future flooding where the issuing criteria have been agreed with emergency management agencies. These agencies may also be provided with a range of likely flood scenarios based on likely future rainfalls to assist in their planning. In some jurisdictions, River Alerts are generated automatically when river levels exceed pre-determined thresholds as an additional alerting mechanism. When flooding either becomes more certain or commences, specific predictions of future river levels at pre-determined forecast locations are made. These predictions are made in accordance with previously specified requirements including critical threshold levels, forecast accuracy and lead time, and continue for the duration of the flooding.

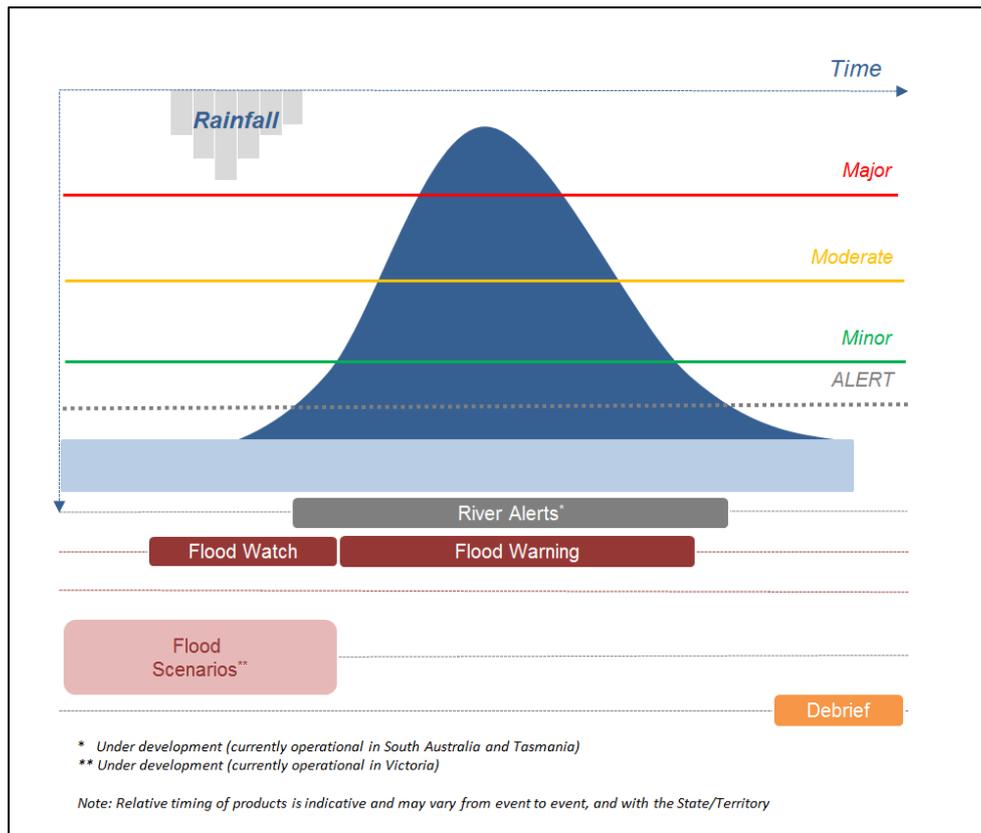
The Bureau prediction at a forecast location can be expressed in different ways dependent on the defined service level and the quality (accuracy) of the hydrologic forecasting tool. Normally it is expressed either as:

- A river level value – e.g. 7.5m
- A river level range – e.g. between 7.5 and 7.8m
- Being above a particular river level value – e.g. greater than 7.5m, or
- A classification (or class) of flooding (based on pre-defined river level thresholds) – e.g. minor, moderate or major.

Forecast locations and service level requirements are specified in detailed schedules contained in Service Level Specifications (SLS) for each State and the Northern Territory. The relative timing of the different flood warning service products is depicted in Figure 4.

---

<sup>16</sup> There are two exceptions; Melbourne Water provides flood forecasting services for Port Philip and Westernport catchments and the South Australian Department of Environment, Water and Natural Resources provides forecasts for the Lower Murray River however the status of these forecasting services is currently under review.



**Figure 4: Relative timing of flood warning products**

Predictions of future river levels are prepared using hydrological forecasting models and other tools. Model inputs include real-time rainfall and river level data from an extensive network of observing sites, weather forecast information and data from the national radar network. The Bureau maintains a sophisticated communications and computing infrastructure with a capability of 24/7 operations. The Bureau continually improves its capability with the development and implementation of new and improved hydrological forecasting models, and on-line operational computing and communications systems.

The rainfall and river level data comes from a network of stations owned and operated by the Bureau and by State, Territory and other local and regional agencies. The Bureau is responsible for the standard of data from its own observing sites and this responsibility includes meeting replacement, maintenance and operating costs. The Bureau owns and operates a portion of the river level network used for flood warning. However, the majority of the river level data (incl. water levels in dams) is provided from observing sites owned and operated by other agencies. These partner agencies also provide a significant portion of the rainfall data. Not all of the data collected by these partner agencies is for the primary purpose of flood warning. The arrangements whereby data from other agency sites is provided to the Bureau varies around the country and follow protocols established for each jurisdiction as described in Data Sharing Agreements and in the Regulations associated with the

*Water Act (2007)*. National standards and a risk-based strategic plan for the further enhancement of this flood warning infrastructure is currently under development (refer Section 6.3).

Typical activities for each level of government for flood monitoring and prediction are listed in Appendix 1.

### 4.3.2 Interpretation of Flood Predictions

A flood prediction is of little value unless people at risk are able to assess what it means in terms of the risk it presents to them in their individual situation. This requires that the prediction as prepared by the Bureau be given meaning. The interpretation of flood predictions is done at a number of different levels and depends on how the prediction is expressed.

#### **Flood Classification Levels**

For all forecast and information locations, standardised flood impacts (or flood classifications) have been determined. These flood classifications describe in general terms the degree and nature of flood impact at and around the forecast location and relate river levels to expected impacts. The classifications currently in use are:

**Minor** - Causes inconvenience. Low-lying areas next to watercourses are inundated. Minor roads may be closed, and low-level bridges submerged. In urban areas inundation may affect some backyards and buildings below the floor level as well as bicycle and pedestrian paths. In rural areas removal of stock and equipment may be required.

**Moderate** - In addition to the above, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood affected areas may be required. In rural areas removal of stock is required.

**Major** - In addition to the above, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the floor level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood affected areas may be required. Utility services may be impacted.

Flood classification levels are determined for each forecast and information location corresponding to the river level (gauge reading) at which the particular impacts as described above commence. The Bureau uses these levels to qualify/categorise the flood prediction by the particular classification so that the expected general impact of the flooding can be communicated with the prediction. Through this use of standard terms describing flood impacts, the Bureau prediction is given some meaning. For this to be effective however, it requires that those hearing/receiving the warning understand what the classification level means to them.

It is important that flood classification levels accurately reflect the impacts at the key river height stations and State/Territory Emergency Service organisations lead the determination, review and update of flood classifications in consultation with the Bureau and relevant State and local agencies.

Nationally consistent guidelines have been developed for the establishment and regular review of the flood classifications, which includes consideration of historic water levels and documented flood impacts, outputs from flood studies, survey information and local knowledge. Flood Warning Consultative Committees (see Section 5.4) play a key role in the endorsement of flood classification levels before being formally adopted.

### **More Specific Interpretation**

When the flood prediction is expressed more precisely, either as a single value or a narrower range of values, more detailed interpretation is possible. This is normally undertaken either by the emergency management agency or local government, dependent on the availability of local flood intelligence. Such flood intelligence allows those agencies to interpret Bureau flood predictions into more detailed impacts on infrastructure (roads, critical life lines etc.) and communities allowing them to better target local warning communications on particular areas at risk at the predicted level. Individuals (households, business owners, etc.) with appropriate detailed knowledge, understanding and/or experience of the relationship between level at the nearest forecast location and impact at their location are able to use the Bureau prediction to plan their response.

Flood intelligence can be developed through the gradual collection and systematic recording of information gathered relating flood impacts to levels on the gauge at the forecast location during flood episodes as well as through flood studies, especially where these include flood inundation modelling and mapping exercises.

Typical activities for each level of government involved in interpretation are listed in Appendix 1.

### **4.3.3 Warning Message Construction and Dissemination**

The warning message is the critical link between flood prediction and interpretation on the one hand and taking appropriate protective action on the other. Current arrangements for providing that link can be multi-layered and include flood warning messages disseminated by the Bureau but can also include more localised and targeted communications from emergency management agencies and local government. Guidance on message construction and composition is provided in the Australian Government publication

“Choosing your Words” (Attorney-General’s Department, 2008)<sup>17</sup>, and Manual 21 Flood Warning (AIDR, 2009)<sup>18</sup>

The Bureau Flood Watch and Flood Warning messages are disseminated primarily through the web and the media and are sent directly to emergency management agencies. Emergency management operations centres are often telephoned on issue of a new or updated warning. The locations for

---

<sup>17</sup> “Choosing your Words” (Attorney-Generals Department, 2008) <https://www.ag.gov.au/Publications/Pages/Emergency-warnings-choosing-your-words.aspx>

<sup>18</sup> Manual 21 *Flood Warning* (AIDR, 2009) <https://knowledge.aidr.org.au/media/1964/manual-21-flood-warning.pdf>

which they are issued are included in the Service Level Specifications for each jurisdiction (see later appendices). The Bureau has a Memorandum of Understanding with the ABC to ensure priority is given to the dissemination of warnings.

In some areas the Bureau message as received by the emergency management agency is further disseminated to local response groups and the community. This may be without any change or may include some local interpretation and tailored action statements. In other cases, the agency may separately generate and communicate more localised messages based on the Bureau predictions, but enhanced with more detailed local knowledge and interpretative information where available.

Typical activities for each level of government involved in warning message construction and dissemination are listed in Appendix 1.

### **4.3.4 Communication with Individuals on their Specific Flood Risk**

It is important to advise and educate people outside of flood time about their individual flood risk, and where this is done the warnings disseminated as floods are approaching will generally be better understood. In many circumstances, people can be provided with the actual gauge height at which their properties will experience over-ground or over-floor inundation or at which their evacuation route will be cut.

Arrangements for providing this sort of advice are generally established at the local level, either through Local Government or State/Territory emergency management agencies.

### **4.3.5 Generating Flood Response Behaviour – Community Alerting and Local Action**

A critical part of any flood warning system is the prompt alerting of the community that flooding will occur. This alerting must be able to operate at any time and is usually through a variety of means. The arrangements for alerting communities when they are at risk from natural disasters are incorporated within the emergency management arrangements for each jurisdiction and normally rests with Local Government, the State emergency management agency and Police.

To assist in this alerting of local communities a decision may be taken within the agreed protocols to issue a flood warning with the Standard Emergency Warning Signal (SEWS). The SEWS is used to communicate emerging situations of extreme danger or when there is a need to warn the public that they need to take some urgent and immediate action to reduce the potential for loss of life or property. This short signal should alert the community to take appropriate actions to protect life and property or to seek guidance from local authorities.

Another means of warning communities is through the use of Emergency Alert (see: [www.emergencyalert.gov.au](http://www.emergencyalert.gov.au)), the national telephone warning system that may be used by police, fire and emergency services to warn a community of a likely or actual emergency. Its use will depend on the circumstances and the system sends a voice message to landline telephones and text

messages to mobile telephones within a specific area defined by the emergency service organisation issuing the warning.

Community education and public awareness programs are another vital tool to achieve effective flood response by continually reminding of the threat of flooding and by informing and keeping fresh details of the flood warning system in place that operates to mitigate the hazard. Responsibility for programs in this area rests primarily with State and Local Government although the Commonwealth plays a role through the public education programs of Emergency Management Australia. More detail on typical activities of each level of government involved in TFWS operations along with flood preparedness is given in Tables 1 and 2 of Appendix 2.

#### 4.3.6 Total Flood Warning System Review

Each agency involved in the operation of the TFWS for a particular flood event normally undertakes a review of its performance during the event as part of internal procedures. For example, the Bureau has developed standard operating procedures for post event review management that are applied consistently across all service groups within the Bureau. In addition to examining internal processes, these reviews include routine performance monitoring and product verification against service level specifications, along with regular client feedback.

Multi-agency review of the operation of the total system, especially involving the interactions between the various agencies and elements of the total system, is also very important however, to some degree this is addressed through the Flood Warning Consultative Committee (see Section 5.4), which operates within the framework of the TFWS in establishing priorities and reviewing performance. Post-flood debriefs, normally initiated by the State emergency management agency and involving key agency stakeholders provide a further opportunity to examine the performance of the multi-agency nature of the TFWS. Following some events, public meetings are convened to allow people and businesses impacted by the flooding to provide feedback. Some detail on typical activities of agencies during this post flood period are given in Table 3 of Appendix 2.

In addition to these more routine reviews of the operation of the TFWS, major reviews of the operation and performance of the flood warning service may be undertaken following significant and notable flood episodes. Such reviews may either be part of a wider review covering all aspects of flood risk management or focussed solely on flood warning. They are most commonly initiated at the State level and vary in form from reviews by independent consultants to full scale public inquiries. Recent examples here are the Queensland Floods Commission of Inquiry (Queensland Flood Commission Website<sup>19</sup>), the Review of 2010-11 Flood Warnings and Response in Victoria (Victorian Flood Review<sup>20</sup>) and the Independent Review into the Tasmanian Floods of June and July 2016<sup>21</sup>.

---

<sup>19</sup> Queensland Flood Commission website: <http://www.floodcommission.qld.gov.au>

<sup>20</sup> Victorian Flood Review website: <http://www.floodsreview.vic.gov.au>

<sup>21</sup> Independent Review into the Tasmanian Floods of June and July 2016 [http://www.dpac.tas.gov.au/government\\_flood\\_review](http://www.dpac.tas.gov.au/government_flood_review)

## 4.4 Operational Coordination Arrangements

### 4.4.1 Australian Government Crisis Coordination Centre

The Australian Government Crisis Coordination Centre (AGCCC) has been designed to connect relevant Australian Government, State and Territory agencies to centralise Australian Government actions during complex national crises, to develop a single, timely and consistent picture or understanding of a crisis, its implications and the national capacity to respond. During major flood episodes, it is anticipated that the Bureau will be liaising closely with this Centre, including providing briefings and posting liaison officers as appropriate to the circumstances. To ensure a whole-of-nation picture of flooding is available in order to maximise the effectiveness of the national response, the National Operations Centre in Melbourne will be the focus for this liaison activity.

### 4.4.2 Commonwealth Level Communications

A protocol exists for the communication of information between national agencies regarding significant severe weather and flood events. The Bureau prepares a Critical Event Brief (CEB) for key hazards such as severe weather, fire weather or heatwave, flood and tropical cyclone. These briefs are sent directly to an agreed email address at the Australian Government Crisis Coordination Centre on a once or twice daily basis. The Australian Government Crisis Coordination Centre is responsible for distributing this to key Commonwealth agencies and government.

### 4.4.3 Incident Control Centres

The emergency or disaster management arrangements in each State and Territory involve the establishment of coordination or control centres during flood events to coordinate the exchange of information, as well as the deployment of people and resources involved in the flood response operation. The Bureau provides briefings into and sometimes contributes staff to work in these centres in some States/Territories. These centres, especially those at the local level, can act to provide the more detailed local interpretation of flood predictions and local dissemination of flood warning information. Such a centre can sometimes operate on a semi-permanent basis so that it can be activated quickly in times of emergency. Dependent on the arrangements, centres at a district level can be established as well as centres at the local level, either within a specific local government area or jointly across several local areas.

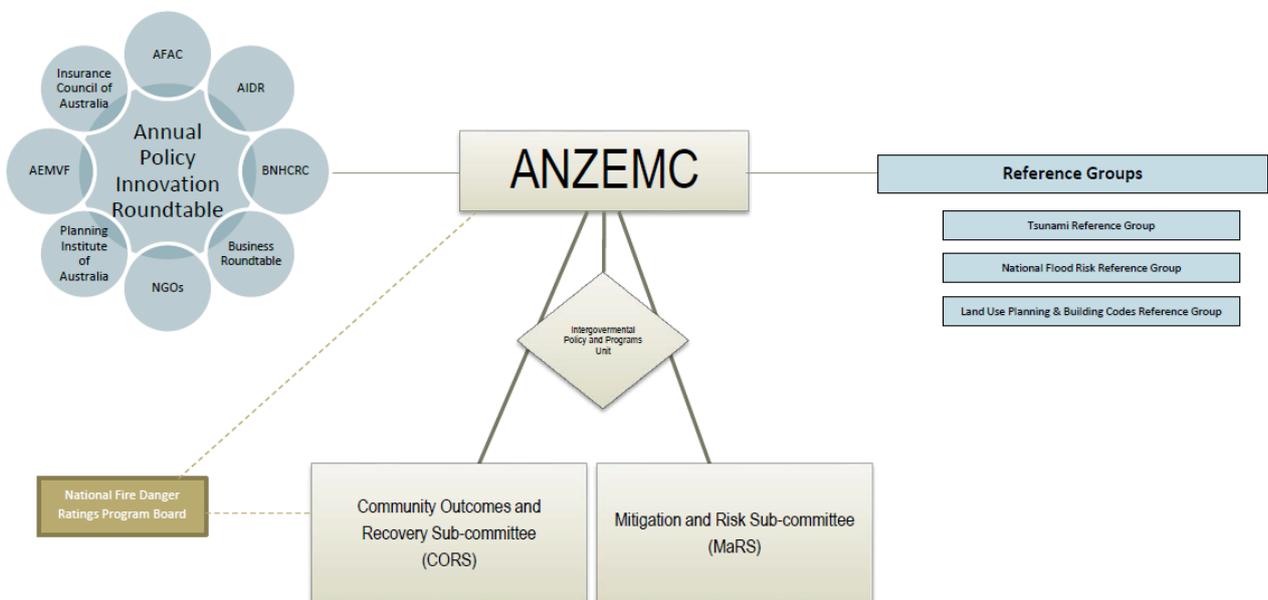
## 4.5 International Arrangements

The Bureau has developed arrangements with related programs in UN agencies such as WMO to benefit from developments internationally as well as contribute Australian expertise in flood forecasting and warning to other countries. A Memorandum of Understanding has recently been established with the Environment Agency (England), the principal flood forecasting and warning agency in England, to promote collaboration and share information and intelligence on flood forecasting and warning. These

relationships provide significant benefit to the Australian service and provide a means of ensuring Australian services are informed by best practice across the field.

## 5. Flood Warning Policy and Coordination

Peak national emergency management coordination is undertaken through the Australia-New Zealand Emergency Management Committee (ANZEMC). ANZEMC works to strengthen disaster resilience by providing strategic leadership on emergency management policy and supported related capability and capacity development activities. ANZEMC meets twice yearly and holds additional meeting as required. ANZEMC has two sub-committees: 1) Community Outcomes and Recovery Sub-committee (CORS) and 2) Mitigation and Risk Sub-committee (MaRS). ANZEMC has two time-limited working groups 1) National Flood Risk Reference Working Group and 2) Register.Find.Reunite Working Group.



**Figure 5. ANZEMC Governance Structure**

### 5.1 Australia-New Zealand Emergency Management Committee

The ANZEMC is co-chaired by the Deputy Secretary Infrastructure, Transport Security and Customs Group in the Department of Home Affairs and a jurisdictional rotational chair.

Australia-New Zealand Emergency Management Committee members are:

- Two senior representatives of the Commonwealth of Australia
- Two senior representatives from the Australian State and Territory government
- A representative from the Australian Local Government Association

- A senior official from the New Zealand Ministry of Civil Defence and Emergency Management

The Department of Home Affairs provides the secretariat for the ANZEMC.

The work of ANZEMC is supported by CORS and MARS (refer Table 1).

<p><b>Community Outcomes and Recovery Sub-committee</b></p> <p>To advise on: community engagement policy and priorities; and, disaster recovery policy and programs. It is proposed to include, among other policy responsibilities, emergency management volunteering.</p>
<p><b>Mitigation and Risk Sub-committee</b></p> <p>To advise on: mitigation policy and programs; and, a recurring national disaster resilience risk statement to guide priorities. It is proposed to include, among other policy responsibilities, public safety communications.</p>

**Table 1. ANZEMC Sub-Committee Roles**

## 5.2 National Flood Risk Reference Group

The National Flood Risk Advisory Group (NFRAG) has been recognised as a Reference Group in the revised ANZEMC structure and will continue to fulfil its current role of being a source of expertise in flood risk management at national forums. This group works to strengthen the resilience to floods by providing strategic leadership and advice on best practice flood risk management. The functions of the NFRAG are to:

- Identify and promote nationally consistent best practice flood risk management.
- Advise on nationally consistent flood risk management policy.
- Provide specialist, expert advice on flood risk management to the work program of the Australian-New Zealand Emergency Management Committee (ANZEMC) and its subcommittees.
- Promote community safety with respect to flooding and flood risk, in support of the Community Outcomes and Recovery Sub-committee of the Australian-New Zealand Emergency Management Committee.
- Identify and prioritise research needs for improving the quality of flood risk management.
- Facilitate and improve communication between flood emergency managers, flood risk managers, land use managers and other stakeholders.

Membership of the NFRAG includes a nominee from each State and Territory government, Australian Government agencies, the Australian Local Government Association, the Insurance Council of Australia, the Australian Building Codes Board and research (currently through the Cooperative Research Centre

for Bushfires and Natural Hazards). Secretariat support is provided by the Australian Government and is currently shared by the Bureau of Meteorology and Geoscience Australia.

The NFRAG coordinates the development and publication of best practice guidelines in floodplain management and other aspects of flood risk management (including flood warning). A recent example here is “Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia<sup>22</sup> (Handbook 7)”. It works to ensure that flood risk management requirements are appropriately coordinated within the development and implementation of national initiatives and policies, in particular the National Strategy for Disaster Resilience. The NFRAG provides a forum through which nationally consistent practices in the development and operation of the TFWS can be identified and promoted.

### 5.3 Bureau of Meteorology Hazard Services Forum

The Bureau of Meteorology Hazard Services Forum (Hazard Services Forum) was established as part of the Intergovernmental Agreement. It is a national forum with the purpose of facilitating consultation with State and Territory emergency services to guide current and future strategic development of the Bureau of Meteorology’s hazard services. Specifically, the forum will provide advice on the appropriateness and relative priority of requested changes to the Bureau’s standard services. Its scope includes those services provided by the Bureau in the public interest in accordance with section 6(2) of the Meteorology Act 1955 (Standard Services) as well as facilitating consultation on other services (Supplementary Services) which incur charges set in accordance with the Commonwealth Cost Recovery Guidelines. The terms of reference of the Hazard Services Forum is included as Appendix 3.

### 5.4 State/Territory Coordination - Flood Warning Consultative Committees

The primary vehicle for achieving coordination among key stakeholders in each jurisdiction is the Flood Warning Consultative Committee (FWCC). These consultative committees were established in the late 1980’s by the Bureau in each State and Territory as part of a set of new arrangements for flood warning proposed at that time by the Commonwealth Government. They are chaired by the Bureau’s State/Territory Manager in each State and the Northern Territory.

The terms of reference for the Flood Warning Consultative Committees are to:

- Identify requirements and review requests for new and upgraded forecasting and warning services.
- Establish the priorities for the requirements that have been identified using risk-based analyses of the Total Flood Warning System.
- Review and provide feedback on the Service Level Specification for the Bureau’s Flood Forecasting and Warning Services on an annual basis.

---

<sup>22</sup> AIDR 2017. Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia. <https://knowledge.aidr.org.au/resources/handbook-7-managing-the-floodplain/>

- Coordinate the implementation of flood warning systems in accordance with appropriate standards.
- Promote effective means of communication of flood warning information to the affected communities.
- Monitor and review the performance of flood forecasting and warning services.
- Build awareness and promote the Total Flood Warning System concept.

Membership of each Flood Warning Consultative Committee typically includes representation from:

- Bureau of Meteorology (Chair);
- State emergency management agency;
- Police
- State water agency(ies);
- Regional/catchment management agency(ies);
- Local government or representative association; and
- Transport and/or main roads authority.

In some jurisdictions, the Flood Warning Consultative Committee provides reports to the State Disaster Mitigation Committee and/or State-based flood committees to assist with coordinating flood warning activities with wider activities in flood risk management and emergency management in the State.

An important role of the Flood Warning Consultative Committee is to regularly review the Service Level Specification for each State and Territory<sup>23</sup> to ensure Bureau services and target performance levels are clear to all stakeholders. This includes reviewing performance against these target levels to identify areas where the systems may need improvement, as well as adjusting services and performance targets to meet changing needs. As part of its more general role to monitor and review the performance of flood warning services, the Flood Warning Consultative Committee acts to facilitate reviews of the performance of all elements of the TFWS in coordination with all stakeholders, to examine the operation of each element as well their interaction in performing as an integrated system.

---

<sup>23</sup> New South Wales covers Australian Capital Territory services.

## 6. Establishing New and Improved Systems

Initiatives for new or improved flood warning systems and services can come about in several ways including;

- Routine reviews of the operation of the TFWS;
- Requirements generated at the local level including those from flood risk studies;
- As an outcome of post-event reviews following a significant flooding episode; or
- As an outcome of State-wide strategy to assess and treat flood risk, such as the Victorian Regional Floodplain Management Strategies<sup>24</sup>, which will all be released by the end of 2018.

The initiatives can be in the form of an improvement to the existing service at a given location (e.g. by enhancing the existing real-time data collection network); adding new forecast locations to an existing system; or establishing a completely new service.

Arrangements for establishing new and/or improved flood warning systems and services need to ensure that:

- The service level requirement is clearly established in relation to flood risk and emergency response plans.
- The solution proposed includes appropriate consideration of all elements of the TFWS and is developed in collaboration with its contributors, to ensure any investment will be effective.
- The solution (e.g. network upgrade, development of forecasting model, etc.) is fully costed including the initial investment costs and ongoing support and maintenance costs.
- The expected performance of the new or improved flood warning service (in terms of service type, accuracy, lead time and robustness) is clearly exposed to the customers and funding agencies (Local Government, SES, State Government), so they can make informed investment decisions.
- The relative priority of the requirement is established within an overall jurisdictional plan or strategy. The new or upgraded service is clearly communicated to all contributors to the TFWS and affected communities have been engaged by the relevant TFWS partners to ensure the service is delivered consistently and with maximum efficacy.

The typical steps involved in establishing a new or improved flood warning system (not flash flood) is essentially the same in each jurisdiction and involves inputs from agencies at all levels of government. However, differences in the nature of their individual agency roles and responsibilities, means that the detail of the process can be different in each jurisdiction. Each Flood Warning Consultative Committee

---

<sup>24</sup> <https://www.water.vic.gov.au/managing-floodplains/regional-floodplain-management-strategies>

plays an important role here in providing the forum for facilitating the necessary coordination among the different agencies to ensure that a complete process is followed. Further detail on the roles of the different agencies in each jurisdiction is provided in the appendices to this document.

### 6.1 Establishing Risk Based Priorities

Priorities for investment in flood warning as a mitigation strategy should ideally be established on the basis of the cost effectiveness of the proposed investment in reducing the overall flood risk exposure within the jurisdiction. For flood warning, the priority is to reduce the risk to loss of life and minimize social disruption and damages. Flood studies are the normal means of generating flood risk information and providing the basis for the development of flood mitigation strategies including the development and upgrade of flood warning systems. Best practice for undertaking such studies is provided in Handbook 7<sup>25</sup>. Some jurisdictions have developed databases of information from these studies (e.g. NSW Flood Data Access Program<sup>26</sup>) and Geoscience Australia (GA) hosts the Australian Flood Studies Database (AFSD) as a component of the Australian Flood Risk Information Portal (AFRIP) (Geosciences Australia – Australian Flood Risk Information Portal<sup>27</sup>). Geoscience Australia also play an important role in the provision of remotely sensed information from satellites that can assist with understanding the flood hazard as well as with forecasting operations.

The preparation of a National Strategic Flood Warning Infrastructure Plan (NSFWIP) is an important development toward ensuring investment in flood warning is effectively based on flood risk. Flood warning infrastructure includes rainfall and river level gauges, data transmission and the ingestion of data into the operational forecasting system. Prevailing inadequacies in standards, network coverage relative to flood risk, and clear understanding of roles and responsibilities in relation to maintenance of flood warning infrastructure have been recognised as an impediment to effective and sustainable flood warning service provision. To address these issues, all jurisdictions agreed to the establishment of a working group (the National Flood Warning Infrastructure Working Group) reporting to the ANZEMC to jointly develop national technical standards and risk-based flood warning infrastructure plans to guide future investment in flood warning infrastructure. This will include work already underway or completed in some jurisdictions toward improved risk-based planning, with the aim of integrating input from each jurisdiction into a more nationally coordinated plan.

The overall risk-based NSFWIP is to be based on individual jurisdictional plans outlining:

- a) Functionality and condition assessment of existing flood warning infrastructure;
- b) Gaps in flood warning infrastructure and knowledge relative to flood risk;
- c) Issues and opportunities;

---

<sup>25</sup> AIDR 2017. Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia.

<https://knowledge.aidr.org.au/resources/handbook-7-managing-the-floodplain/>

<sup>26</sup> NSW Flood Data Access: <https://www.ses.nsw.gov.au/flood-resources/nsw-flood-data-access/nsw-flood-data-access/>

<sup>27</sup> Geoscience Australia – Australian Flood Risk Information Portal: <http://www.ga.gov.au/flood-study-web/#/search>

- d) Priorities, strategies and actions; and
- e) Compliance with national technical standards including transition over time of sub-standard infrastructure to meet appropriate standards.

In addition, a set of national technical standards for the flood warning infrastructure are under development, outlining:

- a) An approach that ensures standards are fit-for-purpose and compatible with the level of flood risk being addressed;
- b) On site, equipment, data format and communication method selection;
- c) Requirements for maintenance, calibration and upgrade of equipment;
- d) Data assurance processes; and
- e) Performance indicators that will include functionality, data latency, asset life cycle management, adequate maintenance, resilience and reliability.

With infrastructure being such a significant component of the Total Flood Warning System costs, the NSFWIP and associated technical standards will form key guidance for ensuring future investments in flood warning are effectively matched to risk.

### 6.4 Flash Flood Warning Systems

The responsibility for establishing and operating flash flood warning systems lies with the States and Territories, working in collaboration with local councils where appropriate. As part of its role in providing support to the development of flash flood warning systems, the Bureau of Meteorology has developed and coordinates FLARE (The Flash Flood Advisory Resource) as a community of practice for assisting responsible agencies to design, implement and manage flash flood warning systems. FLARE is a registered-user website and telephone and email advisory service, and a platform for sharing the knowledge of experts from the Bureau and other agencies around the country. The FLARE website provides easy access to standards and guidelines, case studies and information on the latest Bureau services and products of use in flash flood management. FLARE is freely accessible to any local, territory or state government or consulting engineer with a responsibility to develop flash flood warning systems. FLARE is not an operational service providing event related information during flash flooding.

### 6.5 Funding Programs

#### 6.5.1 National Funding Programs

Funding for new and improved flood warning services comes within the scope of support provided by the Australian Government to the States and Territories to enhance the resilience of communities against the impact of natural disasters. It aims to allow States and Territories to effectively meet the requirements of threatened local communities to enhance their resilience to any natural disaster in the context of their overall risk priorities. This funding is currently managed through the Attorney General's

Department and can include funding provided in partnership with the States and Territories, or directly as part of a targeted program to support high priority disaster resilience initiatives identified at the national level.

### **6.5.2 State and Territory Funding Programs**

Each State and Territory has some form of ongoing program for funding flood mitigation projects, which can include flood warning investments. Arrangements for these vary across the jurisdictions and can involve a shared contribution with local government. Establishing priorities for these investments is normally done within the context of the State flood risk management strategy and may involve consideration of more locally-based issues and political exigencies. The Flood Warning Consultative Committee provides a useful forum to help ensure the project is consistent with other related projects and that appropriate consideration is given to its implementation and operation within the Total Flood Warning System.

### **6.5.3 One-off Funding through Major Initiatives**

Significant injections of funding can be provided either after significant flooding or a major review exercise. These initiatives can come with their own arrangements. To ensure the sustainability and effectiveness of the initiative it is important that these arrangements include consideration of how the investment is made across all elements of the Total Flood Warning System to ensure effectiveness and that funding for the long term operation of any new capability is included. Raising these opportunities with the Flood Warning Consultative Committee provides an opportunity for the necessary coordination across all stakeholders to be achieved such that resources are used most effectively and efficiently.

## 7. Appendices

### Appendix 1 – Typical Activities to Support TFWS Elements

Level of Government	Typical Activities
Commonwealth	<p><b><u>Flood Monitoring and Prediction</u></b></p> <p>Establishing, maintaining and staffing an operational forecasting centre in each capital city (except Canberra).</p> <p>Establishing and maintaining a real-time data collection, processing and storage system.</p> <p>Establish, operate and maintain a portion of the real-time rainfall and river level data collection network. The Bureau responsibility will include meeting all operation and maintenance costs of the equipment used to collect and communicate the data, however this responsibility may be varied by agreement as documented in the Data Sharing Agreements.</p> <p>Establish and maintain good working relationships with partner agencies contributing data.</p> <p>Establish new and improved flood warning systems, including data collection network design and installation, hydrological forecasting model calibration and design of warning products.</p> <p>Operating and supporting a state of the art hydrological forecasting system capable of supporting and generating flood predictions to match requirements documented in the Service Level Specification.</p> <p>Publish rainfall and river level data (maps and bulletins) showing current flood conditions on the Bureau website.</p> <p>Prepare, disseminate and publish flood warnings to match requirements expressed in the Service Level Specification.</p> <p><b><u>Interpretation</u></b></p> <ul style="list-style-type: none"> <li>• Assist local and emergency response agencies to develop flood classification levels at each flood forecast and information location and maintain a data base of these levels for use with flood warning products.</li> <li>• Include appropriate flood classification level with all flood predictions.</li> <li>• Publish current flood classification levels on website.</li> </ul> <p><b><u>Warning Message Construction and Dissemination</u></b></p> <ul style="list-style-type: none"> <li>• Compose and disseminate flood warning messages in accordance with the requirements regarding content and target distribution as set out in each Service Level Specification.</li> </ul> <p><b><u>National Coordination and Response</u></b></p>

	<ul style="list-style-type: none"> <li>The Australian Government Crisis Coordination Centre has the role of centralising Australian Government actions during complex national crises and to develop a single, timely and consistent picture or understanding of a crisis, its implications and the national capacity to respond.</li> </ul>
Level of Government	Typical Activities
State	<p><b><u>Flood Monitoring and Prediction</u></b></p> <ul style="list-style-type: none"> <li>Contributing real-time river level and rainfall data from data networks run by State agencies as defined and to the standards and protocols expressed in the Data Sharing Agreements. In general, the State is responsible for funding the establishment, operation and maintenance of the equipment used to collect and communicate the data to the Bureau; however this responsibility may be varied by agreement as documented in the Data Sharing Agreements.</li> <li>In close cooperation with relevant local and regional agencies and affected communities, landowners and business enterprises, ensure the flood prediction requirements as specified in the Service Level Specification reflect current requirements for effective flood response and that these requirements are communicated to the Bureau.</li> <li>Share with the Bureau any new information gained from flood studies and related analyses that could impact on flood behaviour for incorporation in flood prediction models.</li> <li>If involved in flood prediction for agency-specific operational reasons, ensure this is coordinated and shared with the Bureau where the two activities are inter-dependent, and that predictions are communicated so as not to introduce confusion.</li> </ul> <p><b><u>Interpretation</u></b></p> <ul style="list-style-type: none"> <li>Ensure flood classification levels are current and have been selected so as to reasonably reflect the impacts associated with each of the minor, moderate and major classifications.</li> <li>Ensure flood prediction is linked with available information (flood intelligence) regarding expected impacts at the predicted level.</li> <li>Progressively building flood intelligence data bases (including during flood events) and developing capability for relating flood predictions to impacts.</li> </ul> <p>Include consideration of the needs for improving (or developing new) flood intelligence when planning and undertaking flood risk management studies and strategies.</p> <p><b><u>Warning Message Construction and Dissemination</u></b></p> <ul style="list-style-type: none"> <li>Arrange (including through their local units) for effective communication of the content of Bureau flood warning messages to those at risk as effectively and efficiently as possible (in accordance with best practice).</li> <li>Ensure all available flood intelligence is used effectively in composing and communicating warning messages.</li> <li>Follow emergency warning communication protocols applicable in each particular jurisdiction.</li> </ul> <p><b><u>Protective Behaviour</u></b></p>

	<ul style="list-style-type: none"> <li>• Develop State flood emergency plan.</li> <li>• Support or lead the development of local, regional or catchment-based flood emergency sub-plans.</li> <li>• Train and resource units to respond to flood emergencies.</li> <li>• Develop and maintain flood intelligence to support targeting and resourcing of response activities.</li> <li>• Deliver community education activities and engage community via community-based emergency planning.</li> <li>• Maintain facilities for use as State, regional or incident control centres.</li> </ul>
Regional	<p><b><u>Flood Monitoring and Prediction</u></b></p> <ul style="list-style-type: none"> <li>• Contributing real-time river level and rainfall data from their data networks as defined and to the standards and protocols expressed in the Data Sharing Agreements. This will include data pertaining to the operation of water storages and other water management infrastructure that impacts on flood behaviour. In general, the authority is responsible for funding the establishment, operation and maintenance of the equipment used to collect and communicate the data to the Bureau; however this responsibility may be varied by agreement as documented in the Data Sharing Agreements.</li> <li>• Provide input according to capability and knowledge to ensure the flood prediction requirements as specified in the Service Level Specification reflect current requirements for effective flood response and that these requirements are communicated to the Bureau. This will include information generated through flood studies and floodplain mapping activities.</li> <li>• Share with the Bureau any new information gained from flood studies and related analyses that could impact on flood behaviour for incorporation in flood prediction models.</li> <li>• If involved in flood prediction for agency-specific operational reasons, ensure this is coordinated and shared with the Bureau where the two activities are inter-dependent and communicated so as not to introduce confusion.</li> </ul> <p><b><u>Interpretation</u></b></p> <ul style="list-style-type: none"> <li>• Contribute to the establishment and review of flood classification levels.</li> <li>• Contribute to the improvement of flood intelligence.</li> <li>• Include consideration of the needs for improving (or developing new) flood intelligence when planning and undertaking flood risk management studies and strategies.</li> </ul>
Local	<p><b><u>Flood Monitoring and Prediction</u></b></p> <ul style="list-style-type: none"> <li>• Contributing real-time river level and rainfall data from locally operated data networks as agreed and to the standards and protocols expressed in the Data Sharing Agreements.</li> <li>• If involved in flood prediction for agency-specific operational reasons, ensure this is coordinated and shared with the Bureau where the two activities are inter-dependent and communicated so as not to introduce confusion.</li> </ul>

	<ul style="list-style-type: none"> <li>• Ensure the needs for effective local flood response are reflected in the flood prediction requirements as defined in the Service Level Specification.</li> <li>• Foster community input to the identification of prediction requirements and maintain their awareness as to the particular flood prediction locations most relevant to the local community.</li> </ul> <p><b><u>Interpretation</u></b></p> <ul style="list-style-type: none"> <li>• Contribute to the establishment and review of flood classification levels.</li> <li>• Contribute to the improvement of flood intelligence.</li> <li>• Include consideration of the needs for improving (or developing new) flood intelligence when planning and undertaking flood risk management studies and strategies.</li> <li>• Communicate changes/revisions to flood classification levels to local community in affected area.</li> </ul> <p><b><u>Warning Message Construction and Dissemination</u></b></p> <ul style="list-style-type: none"> <li>• Arrange for further dissemination locally as required under prevailing emergency management arrangements.</li> </ul>
Community	<p><b><u>Flood Monitoring and Prediction</u></b></p> <ul style="list-style-type: none"> <li>• Proactively seek information about level of warning system available and build understanding about flood prediction locations and the flood levels most relevant to managing their personal flood risk.</li> <li>• Ensure personal needs are appropriately reflected in local flood prediction requirements.</li> <li>• Participate in endorsed volunteer flood observation programs.</li> </ul> <p><b><u>Interpretation</u></b></p> <ul style="list-style-type: none"> <li>• Identify forecast location most relevant to individual flood risk and build understanding of appropriate response to predicted flood levels (classifications) for gauge at that location.</li> </ul> <p><b><u>Warning Message Construction and Dissemination</u></b></p> <ul style="list-style-type: none"> <li>• Become familiar with source and likely content of warning messages and provide constructive feedback.</li> <li>• Proactively monitor appropriate media for warning information.</li> </ul>

## Appendix 2 – Typical Activities Undertaken Before, During and After the Flood

Table 1: Summary of Community and Government Roles in Flood Warning – Before the Flood

<b>Before the Flood – Flood Preparedness and Planning</b>				
	<b>Am I at risk?</b>	<b>Is there a warning system for my area?</b>	<b>How can I be prepared?</b>	<b>How is the warning system kept current?</b>
<b>Community</b>	Contact LG, SES to understand whether you are at risk and at what level floods become critical to you	Contact LG, SES. Refer to BoM website for specification of system. Build understanding of level of service available and how products relate to personal flood risk.	Refer to Emergency Management Australia Guide. Prepare a plan. Become familiar with local emergency response plan. Learn how to interpret warning products in personal context. Identify nearest (relevant) forecast location	Regularly refresh knowledge of warning system and response arrangements. Adjust personal plan if situation changes.
<b>Local Government</b>	Understand risk profile for LGA. Utilise available flood mapping. Disseminate flood risk information to constituents.	Maintain awareness of local warning system and keep relevant information current within local community. Become familiar with relevant forecast locations and critical levels. Identify requirements for new/improved systems.	Develop and communicate local level emergency plan. Facilitate preparation of individual plans. Assist community to understand warning information such as flood class levels.	Review forecast needs including flood class levels. Synchronise with response plan. Assist in building flood intelligence for system effectiveness. Share maintenance of data collection assets
<b>Catchment/ Regional/ District Authority</b>	Assist LG with understanding risk profile.	Maintain awareness of local warning system. Assist in specification of forecast needs. Assist in building flood intelligence for system effectiveness. Facilitate requirement for new/improved systems.	Contribute to local emergency plan. Develop regional plan if appropriate.	Coordinate the implementation of flood risk management projects with flood warning system. Share maintenance of data collection assets. Assist in building flood intelligence.
<b>State Government</b>	Undertake State-wide (flood) risk analysis. Support flood mapping initiatives at local and regional (catchment) levels.	Publish information on warning systems operating in State. Assist in specification of forecast needs. Prioritise requirements for new/improved systems.	Develop and communicate State level response plan. Coordinate local and regional plans as appropriate.	Coordinate flood risk management projects with flood warning system. Share maintenance of data collection assets. Prepare flood intelligence to interpret flood predictions. Ensure flood class levels are current and understood.
<b>Commonwealth Government</b>	Funding support (AGD). Promote best practice (nationally consistent) risk analysis (NFRAG, AGD). Publish flood risk information (NFRIP, GA).	Publish details of all national warning systems (BoM). Coordinate/approve requirements for new/improved systems through FWCC.	Funding support (AGD). Promote best practice (NFRAG, AGD).	Maintain online flood forecasting system in state of readiness. Share maintenance of data collection assets. Adapt flood forecasting system to approved new requirements (BoM).

## National Arrangements for Flood Forecasting and Warning

Table 2: Summary of Community and Government Roles in Flood Warning – During the Flood

During the Flood – Total Flood Warning System						
	Monitoring and prediction	Interpretation	Message construction	Warning dissemination	Protective Response Behaviour	
<b>Community</b>	Participate in identifying needs.	Contribute personal requirements to flood intelligence gathering.	Utilise social media opportunities.	Share warning information with neighbours, relatives etc.	Who is responsible for alerting me?	What do I do when I receive/hear a warning?
					Personal responsibility to monitor media and maintain vigilance. Alerting arrangements as in local emergency plan. Emergency Alert system.	Activate personal plan. Cooperate with local response plan. Refer to Emergency Management Australia Guide.
<b>Local Government</b>	Specify prediction requirements. Contribute rain/river data from local networks.	Interpret river level prediction into local impacts.	Prepare message for local dissemination in accordance with jurisdictional arrangements.	Disseminate warning message in accordance with jurisdictional arrangements.	Develop and operate local alerting system (incl. SMS and other social media).	Activate local emergency response plan. Contribute to public education and awareness activities.
<b>Catchment/ Regional/ District Authority</b>	Specify prediction requirements. Contribute rain/river/storage data from local networks.	Interpret river level predictions into local and regional impacts. Provide information on impacts associated with their assets (e.g. water authorities managing storages)	Regional water authorities have responsibility to prepare warnings/advices for dam break or releases that will cause significant river rises	Regional water authorities have responsibility to disseminate warnings/advices related to dam break or significant releases.	Develop and operate local alerting system	Participate in emergency response plan. Contribute to public education and awareness activities.
<b>State Government</b>	Specify prediction requirements. Contribute rain/river/storage data from State-owned networks.	Interpret river level predictions into local and regional impacts. Provide information on impacts associated with their assets (eg water authorities managing storages)	Prepare message from BoM flood warning for local dissemination in accordance with jurisdictional arrangements.	Disseminate warning message in accordance with jurisdictional arrangements.	Activate “emergency alert” system in accordance with established protocols.	Coordinate and control State emergency response plan. Design and sponsor state-wide public education and awareness activities.
<b>Commonwealth Government</b>	Monitor flood threat and predict flood levels (BoM).	Include flood class levels in warning products. Publish current flood class levels (BoM).	Prepare flood warnings and watches in accordance with Service Level Specification (BoM).	Disseminate warning products direct to media, emergency management agencies and publish on website (BoM).	Provide briefing to Australian Government Crisis Coordination Centre.	Provide coordinated Commonwealth response through Australian Government Crisis Coordination Centre. Design and sponsor national public education and awareness activities in coordination with jurisdictional programs.

Table 3: Summary of Community and Government Roles - After the Flood

After the Flood – Review and Ongoing Maintenance & Adaptation		
	Post flood activities	Ongoing between floods
<b>Community</b>	Contribute to debriefs, public forums and post event surveys.	Maintain flood awareness.
<b>Local Government</b>	Participate in official debriefs. Review performance of emergency management roles/systems etc. Review performance of relevant data networks. Contribute to official inquiries and reviews as required. Contribute to FWCC reviews of TFWS.	Review and update flood response plans as required. Continue ongoing flood awareness program. Repair/review/upgrade data networks. Implement new/improved systems.
<b>Catchment/Regional/District Authority</b>	Participate in official debriefs. Review performance of emergency management roles/systems etc. Review performance of relevant data networks. Contribute to official inquiries and reviews as required. Contribute to FWCC reviews of TFWS.	Maintain currency of flood mapping and flood intelligence. Monitor changes in floodplain that impact on behaviour.
<b>State Government</b>	Participate in official debriefs. Review performance of emergency management roles/systems etc. Review performance of relevant data networks. Initiate and contribute to official inquiries and reviews as required. Contribute to FWCC reviews of TFWS.	Review and update flood response planning. Monitor and adapt to relevant technological/organisational changes. Continue community awareness and education programs.
<b>Commonwealth Government</b>	Participate in official debriefs and develop response plans to key identified issues. Review performance of emergency management roles/systems etc. Review performance of relevant data networks. Contribute to official inquiries and reviews as required. Review performance of technical systems. Lead FWCC reviews of TFWS. Produce event reports on the hydrology and meteorology. Update internal flood intelligence and forecasting systems with new information.	Monitor and adapt to relevant technological/organisational changes. Monitor and adapt as necessary to relevant disaster management policy changes. Update intelligence and forecasting systems, including recalibrating flood models. Continue community awareness and education programs.

**Notes:**

- BoM: Bureau of Meteorology
- LG: Local Government
- SES: State Emergency Service
- LGA: Local Government Association
- AGD: Attorney General's Department
- NFRAG: National Flood Risk Advisory Group
- NFRIP: National Flood Risk Information Portal
- GA: Geoscience Australia
- FWCC: Flood Warning Consultative Committee
- TFWS: Total Flood Warning System

## Appendix 3 – Terms of Reference of the Bureau of Meteorology Hazard Services Forum

### Name

Bureau of Meteorology Hazards Services Forum

### Co-Chairs

Group Executive National Forecast Services (Deputy CEO) Bureau of Meteorology and Assistant Secretary, Crisis Management, Emergency Management Australia

### Meeting Regularity

Bi-annually (proposed at end of March and end of September each year) or as required.

### Introduction

The Standardisation of Bureau of Meteorology (Hazards) Services Taskforce was established by the ANZEMC in October 2013. The Taskforce, jointly chaired by the Australian Bureau of Meteorology (the Bureau) and the Australian Attorney-General's Department (AGD), delivered detailed recommendations to the Australia-New Zealand Emergency Management Committee (ANZEMC) and Law Crime and Community Safety Council (LCCSC) of the Council of Australian Governments (COAG) in early 2015 to standardise the Bureau's hazard services to emergency services organisations across Australia and to agree clear allocation of responsibilities to Commonwealth, State, Territory and Local Government for flood management. One of the Taskforce's key outcomes was agreement on a set of nationally-consistent standard and supplementary services covering the Bureau's hazard-related services for fire weather, flood and extreme weather and hazard impact events.

In order to ensure the Bureau's hazard services remain nationally standardised into the future, it was agreed to establish the Bureau of Meteorology Hazards Services Forum (the Hazards Services Forum). The Hazards Services Forum will immediately progress the issues that have remained outstanding from the Taskforce in order to achieve standardisation of all the Bureau's hazard-related services. The establishment of the Hazards Services Forum will be formalised by the signing of a formal agreement between the Commonwealth and State and Territory Governments at the Law Crime and Community Safety Council in late 2015 (the "National Agreement on the Provision of Bureau of Meteorology Hazard Services to States and Territories").

### Purpose

The Hazards Services Forum facilitates consultation with state and territory operational emergency services agencies to guide current and future strategic development of the Bureau of Meteorology's hazard services. Specifically, the Hazards Services Forum will provide advice on the appropriateness

and relative priority of requested changes to the Bureau's standard services, increasing the Bureau's ability to more effectively meet community needs.

### Scope

The scope considered by the Hazards Services Forum includes all hazard related services provided to state and territory emergency services agencies by the Bureau. These services are provided by the Bureau under s6.1(c) of the Meteorology Act 1955 which requires the Bureau to provide advice, forecasts and warnings in relation to meteorological matters including “gales, storms and other weather conditions likely to endanger life or property, including conditions likely to give rise to floods or bush fires” and through other Australian Government policy directives. The following items were considered out-of-scope:

- Services provided by other Commonwealth Government agencies.
- Services provided by the Bureau to Commonwealth Government agencies.
- Other Bureau services not related to natural hazards.
- Natural hazard initiatives owned by and being implemented by the state and territory emergency services agencies within their own State/Territory.

### Responsibilities

The Hazards Services Forum will:

1. Oversee the implementation of the outcomes of the Standardisation of Bureau of Meteorology (Hazards) Services Taskforce, including the roles and responsibilities of the parties as outlined in the “National Agreement on the Provision of Bureau of Meteorology Hazard Services to States and Territories” for the term of the Agreement;
2. Ensure the creation of linkages and relationships between the Hazards Services Forum's work and related projects and activities proposed or taking place within the Commonwealth, State, Territory and Local Government, and maximise possible outcomes presented by future funding opportunities for the improvement of hazard services;
3. Advise emergency services agencies of current and future Bureau capabilities that would contribute to their emergency roles;
4. Take technical advice on matters that impact upon the provision of existing or future Bureau hazard services, and provide advice to the Bureau on the appropriateness and relative priority of proposed changes to standard and supplementary services; and;
5. Examine and provide advice on the strategic directions of the state and territory emergency services agencies in concert with future directions and capabilities of the Bureau's hazard services.

### Operation

The authority, membership and operation for the Hazards Services Forum are as follows:

### **Authority**

The Hazards Services Forum has been established as a consultation mechanism to provide advice from operational emergency services agencies to the Bureau and to ensure that the Bureau's current and future hazard services meet community needs. Giving due consideration to the advice of the Hazards Services Forum, the Director of Meteorology remains responsible for any decisions that impact on the management of the Bureau under the relevant legislation.

### **Membership**

The Group Executive National Forecast Services (Deputy CEO) Bureau of Meteorology and the Assistant Secretary, Crisis Management, Emergency Management Australia, are the Co-Chairs of the Hazards Services Forum.

The other members of the Hazards Services Forum are:

- In addition to the Co-Chairs, no more than one representative from the Bureau of Meteorology and Emergency Management Australia;
- From within the operational emergency services agencies of each state and territory, at least one (no more than two) senior strategic operational officers at the deputy commissioner/assistant commissioner level or other appropriate senior officials;
- At least one (but no more than two) representatives from the Australian Local Government Association; and
- At least one (but no more than two) representatives from the Australasian Fire and Emergency Services Authorities Council.

With the exception of the Co-Chairs, members of the Hazards Services Forum are required to nominate an appropriate proxy that will take their place if they are unable to attend a meeting. The Bureau will provide and fund a Secretary for the Hazards Services Forum.

Membership of the Hazards Services Forum may be altered by agreement between the Co-chairs. Advisers and observers may attend meetings with the prior written approval of the Co-Chairs.

The Hazards Services Forum may, at its discretion, seek and receive advice to assist it in the performing of its duties from:

- Government officers at a Commonwealth or State and Territory level;
- Technical and peak bodies; and
- Other external parties and/or private providers.

At its discretion, the Hazards Services Forum may establish technical working groups to provide advice on specific matters of a technical nature.

The Hazards Services Forum will establish a process to evaluate proposed changes to the Bureau's hazard services against agreed criteria, including its level of national or state/territory priority, resource requirements (initial and ongoing), community benefits and delivery timeframes.

### **Conflict of Interest**

Members of the Hazards Services Forum must declare any interests, whether personal, financial or commercial, which might conflict or restrict provision of fair and independent involvement in Hazards Services Forum matters.

The Co-Chairs must be advised of any such conflicts, whether established, potential or apparent, and take the necessary steps to resolve or otherwise deal with the conflict including the option of deciding that the member should leave the meeting while the matter is under consideration.

### **Confidentiality**

The discussions and papers of the Hazards Services Forum will normally remain confidential unless otherwise communicated through the decisions and minutes of the meetings.

The meeting minutes and papers are 'For Official Use Only'. They should not be released to any person outside the Hazards Services Forum without prior written approval of the Co-Chairs.

The distribution of Hazards Services Forum materials should be limited to required consultation and other parties as determined by the Co-Chairs.

The Secretary to the Hazards Services Forum is responsible for providing advice on security and appropriate marking of papers in line with the Australian Government's standard protective security markings for official information.

### **Agenda and Papers to the Meetings**

Completed papers to be considered by the Hazards Services Forum at the meetings must be provided to the Secretary at least 4 working weeks prior to the set meeting date, unless otherwise agreed.

Papers received after this time will be subject to consideration by the Co-Chairs as to their importance or otherwise for late inclusion on the meeting agenda.

The Secretary will prepare an agenda in consultation with the Co-Chairs. The Secretary will ensure both the agenda and papers are forwarded to Hazards Services Forum members at least 2 working weeks prior to the set meeting date.

### **Timing and Structure of Meetings**

The Hazards Services Forum will meet approximately twice per year in person. Meeting dates will be set in December each year for the following year by the Secretary in consultation with the Co-Chairs and members as required.

Additional meetings may occasionally be called outside of these regular meetings as required at the discretion of the Co-Chairs in consultation with members.

Venue, catering and equipment will be arranged, and costs will be met by the Bureau. Travel expenses of jurisdictions will be met by jurisdictions.

### **Minutes of Meetings**

If significant disagreements arise regarding the contents of the minutes, the Secretary will consult with the Co-Chairs before amendments are made.

Minutes will be distributed to members once signed-off by the Co-Chairs.

### **Review of Terms of Reference**

These Terms of Reference can be reviewed at the discretion of the Hazards Services Forum. Changes to these Terms of Reference require the endorsement of the Co-Chairs.

Please note: Minor amendments to the Terms of Reference are expected prior to the next Hazards Services Forum Meeting in November 2018.

## Appendix 4 – Flood Warning Arrangements in Victoria

### Flood Risk Management and Emergency Management in Victoria

The Victorian Floodplain Management Strategy<sup>28</sup> (VFMS) 2016 outlines policy, actions, accountabilities, and funding arrangements for the Total Flood Warning System (TFWS) in Victoria.

The Department of Environment Land Water and Planning (DELWP) has the accountability for the co-ordination of, and performance reporting on, the TFWS at the state level.

The Catchment Management Authorities (CMAs) and Melbourne Water coordinate regional floodplain management strategies (RFMS) in partnership with VICSES, Local Government, and local communities. These RFMS include agreed priorities for TFWS improvements at the regional and local levels, that align with each local community's risks, and with community's willingness to fund.

DELWP publishes a state wide TFWS Development Plan documenting agreed priorities for TFWS improvements.

Arrangements for responding to floods in Victoria can be found in State Emergency Response Plan – Flood Sub-Plan (Edition 1), referred to as the Flood Sub-Plan hereafter. The plan is available at VICSES Emergency Plans<sup>29</sup> and outlines arrangements for ensuring an integrated and coordinated approach to the State's response to flood events.

The Emergency Management Manual Victoria contains the policy and planning documents for emergency management in Victoria. It provides details about the roles and responsibilities of different organisations in the emergency management arrangements that apply in the State. An on-line version of the manual is available at: Victorian Emergency Management Manual<sup>30</sup>

The specific responsibilities of agencies at each level of government for the TFWS in Victoria are summarised below.

### Operating Arrangements

#### Flood Monitoring and Prediction

The Bureau has responsibility for flood monitoring and prediction and the preparation of warnings for all catchments in Victoria with the exception of Port Phillip and Westernport catchments for which Melbourne Water is responsible. In fulfilling this responsibility, the Bureau collects real time rainfall and river level data for all catchments, including Port Phillip and Westernport catchments. The Bureau is

<sup>28</sup> Victorian Department of Environment, Land, Water and Planning Floodplain Management Strategy: <https://www.water.vic.gov.au/managing-floodplains/new-victorian-floodplain-management-strategy>

<sup>29</sup> VICSES Emergency Plans: <https://www.ses.vic.gov.au/em-sector/VicSESVICSES-emergency-plans>

<sup>30</sup> Emergency Management Victoria – Emergency Management Manual <https://www.emv.vic.gov.au/policies/emmv>

responsible for the dissemination of flood forecasts and warnings throughout the period of flooding including those prepared by Melbourne Water. These forecasts and warnings are disseminated to State agencies, CMAs, local government, Water Corporations and selected private entities and the media in accordance with the service levels as set out in the Service Level Specification for Victoria. Flood Watches and Flood Warnings are published on the Bureau website along with rainfall and river level data for all catchments covered by the service.

For locations downstream of major storages impacted by storage operations, the storage operators provide flood predictions in accordance with the Service Level Specification for Victoria. The arrangements relating to the management of flooding consequences downstream of dams are included in the State Flood Emergency Plan Flood Sub-Plan.

All agencies owning, and operating rainfall and river level sites used for riverine flood warning services in Victoria provide the data to the Bureau or allow direct access to sites in near real time in accordance with details included in data sharing agreements.

### Interpretation

Local flood intelligence is used to interpret local level consequences based on the Bureau flood warnings and predictions. This interpretation function can be performed by emergency services, CMAs, Water Corporations, and consultant flood specialists

VICSES, with support from DELWP, is accountable for determining the necessary qualifications and competencies required to provide these interpretation functions. DELWP, Melbourne Water and CMAs are accountable for maintaining the expertise to provide these interpretation functions.

### Establishment of Flood Class Levels

The need to revise or establish a new Flood Class Level (FCL)<sup>31</sup> can be identified by DELWP, CMAs, VICSES, local government or the relevant Water Corporation. This need can be based on observed flood behaviour and/or informed by local flood studies.

The new or revised levels are reviewed by VICSES, the Bureau, DELWP, CMAs, and local government for feedback. DELWP will then endorse the new or revised FCL, after which they are forwarded to the Bureau for inclusion in forecast and warning procedures and the Service Level Specification for Victoria.

The Bureau has developed guidance material to assist with FCL revision.

### Warning Dissemination

The responsibility for disseminating warnings and related information to the communities at risk, either at the onset or during periods of flooding, rests with the Bureau and VICSES. Local government are

---

<sup>31</sup> The definition of each Flood Class Level is given in the main body of this document.

responsible for supporting this critical function by sharing information with the community, using local channels and networks.

The Bureau disseminates flood warnings through its web pages, the media and direct to emergency agencies (in particular VICSES), relevant regional authorities (CMAs and regional Water Corporations) and councils (local government).

For the Port Phillip and Westernport catchments the Bureau disseminates flood warnings based on flood predictions prepared by Melbourne Water.

VICSES disseminates Flood Community Notifications (advice and warnings), to affected communities and key support organisations using the VicEmergency arrangements. Where possible, local flood impacts/consequences are included in these advice and warning messages. Flood Community Notifications are distributed to the community through the VICSESVicEmergency website, app, social media channels and hotline, and through the media. The notifications are also distributed via VICSES social media channels and direct to other emergency services organisations.

Storage operators, in consultation with VICSES, may apply site specific dissemination arrangements immediately downstream of significant water storages.

### Generating Flood Response Behaviour

A critical part of any flood warning system is the prompt alerting of the community that flooding will occur. This alerting must be able to operate at any time and is usually through a variety of means. The prime responsibility for implementing and operating flood alerting procedures for local communities' rests with VICSES. Local government has responsibility for actions at a local level in order to respond to the flood and sharing information with the community. The alerting procedures and actions are contained in Municipal Flood Emergency Plans (MFEPs).

Individuals can be alerted directly through VicEmergency channels (website, app, social media, hotline) as well as the Emergency Alert (Emergency Alert Website<sup>32</sup>) system, which is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a defined area, about likely or actual emergencies including floods. The Standard Emergency Warning Signal (SEWS<sup>33</sup>) may be played prior to the community notification being read on radio stations. Community sirens can also be used to alert the community.

### Community Information

Flood education and engagement activities are a VICSES and local government responsibility.

---

<sup>32</sup> Emergency Alert Website: <http://www.emergencyalert.gov.au/>

<sup>33</sup> SEWS – Standard Emergency Warning Signal: [http://www.police.vic.gov.au/content.asp?Document\\_ID=23388](http://www.police.vic.gov.au/content.asp?Document_ID=23388)

Information and support to individuals and communities is available through VICSES - FloodSafe<sup>34</sup>, Local Flood Guides<sup>35</sup> for selected locations and Flood Victoria Website<sup>36</sup>. Information may also be on the relevant local government websites. Advice to individuals on what to do before, during and after a flood is at: Emergency Management Australia Guide<sup>37</sup>.VICSES

### Consultation and Coordination during Floods

Victoria establishes a hierarchy of operational control arrangements during flood emergencies including a State Control Centre supported by Regional Control Centres, as required, and local Incident Control Centres. A Bureau meteorologist is based at the State Control Centre all year round to provide weather-related briefings. Bureau hydrologists provide briefings on flood related issues to State and Regional emergency management teams. Bureau hydrologists also liaise on specific flooding issues with emergency management and other agencies through the regional and/or local Incident Control Centres. There is a significant level of direct briefings to agency officials during floods.

## Formal Service Level and Data Provision

### Service Level Specification

The Service Level Specification for Victoria describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of Meteorology in Victoria. This specification can be found here: Victorian Service Level Specification<sup>38</sup>

### Data Sharing Agreement

The data sharing agreements in place or under development for supporting flood forecasting and warning services in Victoria are between the Bureau and:

- Regional Water Monitoring Partnership Participants
- Gippsland Ports
- Goulburn Murray Water
- Southern Rural Water
- Snowy Hydro
- East Gippsland Water

## Systems Maintenance and Support

---

<sup>34</sup> Victorian State Emergency Service Floodsafe website: <https://www.ses.vic.gov.au/get-ready/floodsafe>

<sup>35</sup> Victorian State Emergency Local Flood Guides website: <https://www.ses.vic.gov.au/get-ready/your-local-flood-information>

<sup>36</sup> Flood Victoria website: <http://www.floodvictoria.vic.gov.au/>

<sup>37</sup> Emergency Management Australia Guide for "What to do before, during and after a flood?" (Attorney Generals Department, 2005, [http://www.bom.gov.au/water/floods/document/What\\_todo\\_floods.pdf](http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf))

<sup>38</sup> Victorian Service Level Specification document: [http://www.bom.gov.au/vic/flood/brochures/VIC\\_SLS\\_current.pdf](http://www.bom.gov.au/vic/flood/brochures/VIC_SLS_current.pdf)

The VFMS sets out the accountabilities and funding arrangements for the ongoing maintenance and support of the flood warning related data collection networks. The Victorian Water Monitoring Partnership Agreements and the data sharing agreements for flood warning data collection detail gauge specific arrangements.

The Bureau is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

## Appendix 5 – Flood Warning Arrangements in New South Wales and the Australian Capital Territory

### Flood Risk Management and Emergency Management in New South Wales and the Australian Capital Territory

Arrangements for the emergency management of flooding in New South Wales (NSW) are set out in the New South Wales State Flood Sub Plan (March 2015)<sup>39</sup>. The plan sets out the emergency management aspects of prevention, preparation, response and initial recovery arrangements for flooding and the responsibilities of agencies and organisations with regards to these functions. The plan identifies the New South Wales State Emergency Service (NSWSES) as the designated Combat Agency for controlling flood operations in NSW. The functions of the Bureau of Meteorology are set out in the plan under the headings of preparedness and response. The Bureau's main role is to act as the prediction agency, including the collection and provision of real time rainfall and river level data, formulate and issue official forecasts and warnings, as well as contributing to flood education in coordination with the SES. As part of the Flood Sub Plan, owners of gated dams are required to provide all available information to the Bureau and NSWSES on storage levels and actual and prospective water releases and their likely impacts on downstream river levels. WaterNSW, as New South Wales bulk water supplier and river operator, operate an automated notification system to advise subscribers of any significant dam release or emergency situation.

The arrangements for managing flood prone land in NSW are detailed in the State Government's Flood Prone Lands Policy as set out in the Floodplain Development Manual (2005)<sup>40</sup> which covers floodplain management matters gazetted under the Local Government Act 1993. The management of flood prone land is, primarily, the responsibility of councils, with specialist technical assistance provided by the NSW Government through the Office of Environment and Heritage and the SES. This arrangement includes the establishment of local floodplain risk management committees through which local community groups and individuals can communicate on flood risk management issues. The implementation of the Flood Prone Lands Policy is supported by the Floodplain Management Grants Program<sup>41</sup>. This program can support flood warning and is guided by an assessment committee that includes representation from the Bureau of Meteorology among other stakeholders.

Responsibilities for flood warning in the Australian Capital Territory (ACT) are shared between the Bureau of Meteorology and the ACT Emergency Services Agency (specifically the ACT State Emergency Service (ACTSES)), with roles as detailed below.

---

<sup>39</sup> New South Wales State Flood Sub Plan (March 2018) <https://www.emergency.nsw.gov.au/Documents/plans/sub-plans/SubPlan-Flood.pdf>

<sup>40</sup> Floodplain Development Manual: <https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Water/Floodplains/floodplain-development-manual.pdf>

<sup>41</sup> Floodplain Managements Grant Program: <https://www.environment.nsw.gov.au/coasts/Floodgrants.htm>

## Operating Arrangements

### Flood Monitoring and Prediction

The Bureau of Meteorology has responsibility for flood monitoring and prediction throughout New South Wales and the ACT, as well as for the dissemination of flood forecasts and warnings of minor, moderate or major flooding throughout the period of flooding. These forecasts and warnings are disseminated primarily to the NSWSES and ACTSES for further dissemination and response according to arrangements in the New South Wales State Flood Sub Plan and the service levels as set out in the Service Level Specification for New South Wales and the ACT (see 5.3.1). Flood Watches and Flood Warnings are published on the Bureau website along with rainfall and river level data for catchments covered by the service.

### Interpretation

The NSWSES as the control agency for flood emergencies in New South Wales provides a 24 hour flood warning dissemination service. This role includes interpreting Bureau flood warnings and predictions into impacts at the local level in accordance with local flood intelligence, and prepares and disseminates local flood bulletins to those at risk. The ACTSES is responsible for interpreting Bureau flood warnings and predictions for the ACT.

### Establishment of Flood Class Levels

The need to review or establish a new Flood Class Level<sup>42</sup> at a locality follows a consultative process involving the Bureau of Meteorology, SES and the affected community. Information from flood studies can help inform the process but recommendations to update a Flood Class Level normally follows an actual flood where there is an identified need, either from operational intelligence or community feedback. Proposals for change are discussed widely, including community consultation around any proposed change. SES have formalised a procedure for justification of any change and, once supported internally and with the Bureau, consultation with the community occurs after which the proposed/endorsed change is tabled at the FWCC.

### Warning Dissemination

The SES has primary responsibility for disseminating flood warnings in New South Wales. This involves generating and issuing flood bulletins based on Bureau flood predictions with advice on the local impact of these predictions. These bulletins are subsequently disseminated in accordance with the coordination arrangements that have been established among regional and local control groups.

### Generating Flood Response Behaviour

---

<sup>42</sup> The definition of each Flood Class Level is given in the main body of this document.

The prime responsibility for implementing and operating flood alerting procedures for communities rests with the SES working in close cooperation with local councils and other emergency management agencies. The alerting procedures and actions are contained in the New South Wales State Flood Sub Plan.

Community education about flooding is vital for people in and surrounding flood affected areas. This education is paramount to the community's effective response. Responsibility for education is primarily a responsibility of the SES and local floodplain management authorities. Information generated as part of flood warning system upgrades (e.g. response guidelines, flood level information guides, flood inundation maps etc.) should be used to improve community awareness.

Emergency Alert (Emergency Alert Website<sup>43</sup>) is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a defined area about likely or actual emergencies including floods. The Standard Emergency Warning Signal (SEWS)<sup>44</sup> may also be used.

### Community Information

Information and support to individuals and communities is available State-wide through: New South Wales Flood Safe Website<sup>45</sup>. Advice to individuals on what to do before, during and after a flood is at: Emergency Management Australia Guide<sup>46</sup>.

### Consultation and Coordination during Floods

The Bureau of Meteorology maintain close contact with the New South Wales State Emergency Service at all operational levels during floods to assist with interpreting flood predictions and related flood operational matters.

## Formal Service Level and Data Provision

### Service Level Specification

The Service Level Specification for New South Wales and the Australian Capital Territory describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of Meteorology in both jurisdictions. This specification can be found at: New South Wales and Australian Capital Territory Service Level Specification<sup>47</sup>.

---

<sup>43</sup> Emergency Alert Website: <http://www.emergencyalert.gov.au/>

<sup>44</sup> Standard Emergency Warning Signal (SEWS): <https://www.emergency.nsw.gov.au/Pages/for-the-community/alert-NSW/SEWS.aspx>

<sup>45</sup> New South Wales State Emergency Service Floodsafe website: <http://www.floodsafe.com.au/>

<sup>46</sup> Emergency Management Australia Guide for "What to do before, during and after a flood?" (Attorney Generals Department, 2005, [http://www.bom.gov.au/water/floods/document/What\\_todo\\_floods.pdf](http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf))

<sup>47</sup> New South Wales and Australian Capital Territory Service Level Specification: [http://www.bom.gov.au/nsw/NSW\\_SLS\\_Current.pdf](http://www.bom.gov.au/nsw/NSW_SLS_Current.pdf)

In New South Wales flood warnings are also provided for 13 smaller sub-catchments with faster catchment response times (rain-to-flood times of less than six hours) that have specialized warning systems in place<sup>48</sup>.

### Data Sharing Agreement

The data sharing agreements in place or under development for supporting flood forecasting and warning services in New South Wales and the Australian Capital Territory are between the Bureau of Meteorology and:

- Office of Environment and Heritage for Manly Hydraulics Laboratory data;
- Water NSW
- Transport Canberra and City Services
- Sydney Water

### Systems Maintenance and Support

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the data sharing agreements for flood warning data collection. Each data sharing agreement includes arrangements for emergency callouts for network maintenance in times of flooding.

The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

### Service Planning and Coordination

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. This requires that the agencies establish and maintain arrangements outside of flood times and the primary means of achieving such coordination among agencies involved in the Total Flood Warning System in New South Wales and the Australian Capital Territory is the Flood Warning Consultative Committee. Membership of this Committee is:

- Bureau of Meteorology (Chair and Secretariat)
- New South Wales State Emergency Service
- New South Wales Office of Environment and Heritage
- Floodplain Management Australia

---

<sup>48</sup> Action is planned to review these arrangements as part of the standardisation of services.

- Water NSW
- Australian Capital Territory State Emergency Service
- Sydney Water

## Appendix 6 – Flood Warning Arrangements in Queensland

### Flood Risk Management and Emergency Management in Queensland

Disaster management arrangements in Queensland are founded in the Disaster Management Act 2003 and are structured around:

- Disaster management groups operating at local, district and State levels and which are responsible for the planning, organisation, coordination and implementation of all measures to mitigate/prevent, prepare for, respond to and recover from disasters;
- Coordination centres at local, district and State levels that support disaster management groups in coordinating information, resources and services necessary for disaster operations;
- State government functional agencies through which the functions and responsibilities of the State government in relation to disaster management are managed and coordinated; and
- State government threat-specific agencies responsible for the management and coordination of combating threats.<sup>49</sup>

Detailed arrangements describing specific agency responsibilities are found in the Queensland State Disaster Management Plan (September 2016)<sup>50</sup>.

The Queensland Reconstruction Authority (QRA) is the lead agency for disaster recovery, resilience and mitigation policy. While local government has the primary responsibility for managing flood risk, QRA provides guidance and support through improved floodplain mapping and flood studies to assist councils with introducing consistent planning controls to manage flood risk, and to ensure a consistent approach across the State.

### Operating Arrangements

#### Flood Monitoring and Prediction

The Bureau of Meteorology has responsibility for flood monitoring and prediction in Queensland and for the dissemination of riverine flood forecasts and warnings. These forecasts and warnings are disseminated to State, District and Local Disaster Coordination Centres and the media in accordance with the service levels as set out in the Service Level Specification for Queensland.

Flood Watches and Flood Warnings are published on the Bureau website along with rainfall and river level data for catchments and river basins covered by the service.

---

<sup>49</sup> Taken from Queensland Disaster Management Arrangements: <https://www.disaster.qld.gov.au/dmg/Pages/DM-Guideline.aspx>

<sup>50</sup> <https://www.disaster.qld.gov.au/cdmp/Documents/Queensland-State-Disaster-Management-Plan.pdf>

## Interpretation

The interpretation of Bureau flood warnings and predictions into local impacts is a function undertaken by the State Disaster Coordination Centre (SDCC) and the Local Disaster Management Group. Under the Act, local disaster management plans must ensure the community is aware of ways of mitigating the adverse effects of a hazardous event, and preparing for, responding to and recovering from a disaster.

## Establishment of Flood Class Levels

The establishment of flood class levels<sup>51</sup> primarily rests with local government. The Bureau has developed a guidance document to support the annual review of flood classifications, which is coordinated by QFES with support from the QRA.

## Warning Dissemination

Flood Warnings are disseminated by the Bureau directly to those agencies having emergency management responsibilities at the local, regional and State levels as well as the media. The list of agencies involved is tailored to correspond with the area under threat and designed to meet the requirements of the State Disaster Management Plan. Guidelines have been prepared for the management and dissemination of information and warnings to the public during disaster events. Flood Warnings are also published on the Bureau website along with rainfall and river level data for catchments covered by the service.

## Generating Flood Response Behaviour

Local Disaster Management Groups have the lead role for disaster operations including flood response within their jurisdiction consistent with their disaster management and operation plans.

Individuals can be directly alerted through the Emergency Alert (Emergency Alert Website<sup>52</sup>) system, which is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a definable polygon area about likely or actual emergencies, including floods. Queensland Fire and Emergency Services (QFES) have the operational responsibility for activating and disseminating Emergency Alert messages in Queensland. The Standard Emergency Warning Signal (SEWS)<sup>53</sup> may also be used.

## Community Information

---

<sup>51</sup> The definition of each Flood Class Level is given in the main body of this document.

<sup>52</sup> Emergency Alert Website: <http://www.emergencyalert.gov.au/>

<sup>53</sup> Standard Emergency Warning Signal (SEWS): <https://www.disaster.qld.gov.au/dmg/Response/Pages/5-6.aspx>

Information and support to individuals and communities is available State-wide through the Queensland Government *Get Ready Queensland* program<sup>54</sup>. Advice to individuals on what to do before, during and after a flood is at: Emergency Management Australia Guide<sup>55</sup>.

### Consultation and Coordination during Floods

Coordination and consultation among agencies responsible for emergency management during flood operations in Queensland is achieved through a hierarchy of disaster coordination centres at the local, district and State levels which are activated as the need arises to coordinate resources, information and to provide support. The Bureau of Meteorology maintains close and regular contact with these centres during flood operations.

## Formal Service Level and Data Provision

### Service Level Specification

The Service Level Specification for Queensland describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of Meteorology in Queensland. This specification can be found at: Queensland Service Level Specification<sup>56</sup>.

### Data Sharing Agreement

The Data Sharing Agreements in place for supporting flood forecasting and warning services in Queensland are between the Bureau of Meteorology and:

- Sunwater;
- Department of Natural Resources and Mines (DNRM);
- SEQ Water;
- Queensland Rail;
- Maranoa Regional Council

## Systems Maintenance and Support

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the Data Sharing Agreements for flood warning data collection. Each Data Sharing Agreement includes best endeavour arrangements for emergency callouts by the data provider for network maintenance in times of flooding.

The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting

---

<sup>54</sup> Get Ready Queensland (floods): <https://getready.qld.gov.au/natural-disasters/flood/>

<sup>55</sup> Emergency Management Australia Guide for *What to do before, during and after a flood?* (Attorney Generals Department, 2005, [http://www.bom.gov.au/water/floods/document/What\\_todo\\_floods.pdf](http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf))

<sup>56</sup> Queensland Service Level Specification document: [http://www.bom.gov.au/qld/flood/brochures/QLD\\_SLS\\_current.pdf](http://www.bom.gov.au/qld/flood/brochures/QLD_SLS_current.pdf)

models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

### Service Planning and Coordination

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. This requires that the agencies establish and maintain arrangements outside of flood times and the primary means of achieving such coordination among agencies involved in the Total Flood Warning System in Queensland is the Flood Warning Consultative Committee. Membership of the Queensland Flood Warning Consultative Committee is:

- Bureau of Meteorology (Chair and Secretariat)
- Inspector-General Emergency Management
- Queensland Department of Emergency Services
- Queensland Department of Natural Resources, Mines and Energy
- Queensland Department of Infrastructure, Local Government and Planning
- Queensland Department of Transport and Main Roads
- Local Government Association of Queensland
- Queensland Reconstruction Authority
- Seqwater (Queensland Bulk Water Supply Authority)
- Sunwater

Additional organisations invited to participate include:

- Queensland Police Service
- Brisbane City Council

### Dam Release Communications

As owners of major dams in Queensland, Seqwater and Sunwater communicate information and warnings of releases of water from their various storages<sup>57</sup>. The Inspector General Emergency Management has recently undertaken a review<sup>58</sup> of these communications and made a number of recommendations which are currently being implemented by relevant Queensland agencies.

---

<sup>57</sup> Sunwater: <http://www.sunwater.com.au/community/living-near-dams> and Seqwater: <http://www.seqwater.com.au/dam-release-information-service>

<sup>58</sup> <http://www.disaster.qld.gov.au/Disaster-Resources/dmreview/Pages/Seqwater-Sunwater-warnings.aspx>

## Appendix 7 – Flood Warning Arrangements in the Northern Territory

### Flood Risk Management and Emergency Management in the Northern Territory

Flood warning services in the Northern Territory operate within the context of Territory policies and strategies for flood risk and emergency management, as these strategies guide the actions of Territory agency partners in the overall management of flood risk in the Northern Territory. The Northern Territory Department of Environment and Natural Resources is responsible for flood risk management related to land use planning in the Northern Territory. The Northern Territory Emergency Service is responsible for flood risk management related to flood response and emergency preparations.

The specific responsibilities of agencies in the Northern Territory in providing flood forecasting and warning services are summarised below.

### Operating Arrangements

#### Flood Monitoring and Prediction

The Bureau of Meteorology has responsibility for flood monitoring and prediction for areas of the Northern Territory as outlined in the Service Level Specification for the Northern Territory. The Bureau is responsible for the dissemination of flood forecasts and warnings of minor, moderate or major flooding throughout the period of flooding for the specified forecast locations in the Service Level Specification for the Northern Territory. These forecasts and warnings are disseminated to the Northern Territory Emergency Service, the Police, the Department of Environment and Natural Resources and the media in accordance with the service levels as set out in the Service Level Specification for the Northern Territory. Flood Watches and Warnings are published on the Bureau web site along with rainfall and river level data for catchments covered by the service.

#### Interpretation

The Northern Territory Emergency Service and the Northern Territory Police interpret Bureau flood warnings and predictions into impacts at the local level in accordance with local flood intelligence.

#### Establishment of Flood Class Levels

The need to review or establish a new Flood Class Level<sup>59</sup> at a locality is identified by consultation between the Bureau of Meteorology, the Northern Territory Emergency Service, Police, the Department of Environment and Natural Resources and local authorities. The levels are established from local information informed by flood studies and flood emergency plans as available to best match the definitions of each classification. The levels are reviewed by the Northern Territory Flood Warning

---

<sup>59</sup> A description of Flood Class Levels is found in the main body of the document.

Consultative Committee (FWCC) and then provided to the Bureau (and other agencies) for inclusion in forecast and warning procedures.

### Warning Dissemination

The responsibility for disseminating warnings and related information to the communities at risk at the onset or during periods of flooding rests in the main with the Bureau of Meteorology, the Northern Territory Emergency Service and Police. The Bureau disseminates flood warnings through its web pages, the media and direct to the Northern Territory Emergency Service and Police. These agencies in turn disseminate warning information (Bureau content as well as some local interpretation as available) further at the local community level. The dissemination is in accordance with agency responsibilities and specific local arrangements in emergency management plans.

### Generating Flood Response Behaviour

The prime responsibility for implementing and operating flood response procedures for communities rests with the Northern Territory Emergency Service and, where appropriate, Police and local authorities.

Community education about flooding is vital for people in and surrounding flood affected areas and is primarily the responsibility of the Northern Territory Emergency Service.

Individuals can be directly alerted through the Emergency Alert (Emergency Alert Website<sup>60</sup>) system, which is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a defined area about likely or actual emergencies including floods. The Standard Emergency Warning Signal (SEWS)<sup>61</sup> may also be used.

### Community Information

Information and support to individuals and communities is available at: Northern Territory Emergency Service - Floods<sup>62</sup>. Advice to individuals on what to do before, during and after a flood is at: Emergency Management Australia Guide<sup>63</sup>.

### Consultation and Coordination during Floods

The Bureau of Meteorology maintains close contact with the Northern Territory Emergency Service and the Regional Controller in the lead up to and during flood events. Liaison with Police personnel responding to floods may also occur during flood events.

---

<sup>60</sup> Emergency Alert Website: <http://www.emergencyalert.gov.au/>

<sup>61</sup> Standard Emergency Warning Signal (SEWS): <http://www.emergencyalert.gov.au/frequently-asked-questions/what-is-emergency-alert/75-3-what-is-the-standard-emergency-warning-signal.html>

<sup>62</sup> Northern Territory Emergency Service Floods website: <http://www.pfes.nt.gov.au/Emergency-Service/Public-safety-advice/Floods.aspx>

<sup>63</sup> Emergency Management Australia Guide for "What to do before, during and after a flood?" (Attorney/Generals Department, 2005: [http://www.bom.gov.au/water/floods/document/What\\_todo\\_floods.pdf](http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf))

For larger or widespread events the Northern Territory Emergency Management Council may organise meetings with the Northern Territory Government agencies responsible for relevant aspects of the local Flood Response Plans to coordinate community response to the flood. The Bureau of Meteorology will attend these meetings either in person or by telephone when requested by the Regional Controller (subject to operational availability).

### Formal Service Level and Data Provision

#### Service Level Specification

The Service Level Specification for the Northern Territory describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of Meteorology in the Northern Territory. This specification can be found at: Northern Territory Service Level Specification<sup>64</sup>

#### Data Sharing Agreement

A Data Sharing Agreement for supporting flood forecasting and warning services in the Northern Territory has been developed between the Bureau of Meteorology and the Department of Natural Resources and Environment.

### Systems Maintenance and Support

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the data sharing agreement for flood warning data collection. The data sharing agreement includes arrangements for emergency callouts for network maintenance in times of flooding. The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

### Service Planning and Coordination

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. This requires that the agencies establish and maintain arrangements outside of flood times and the primary means of achieving such coordination among agencies involved in the Total Flood Warning System in the Northern Territory is the Flood Warning Consultative Committee (NTFWCC). Membership of the Committee is:

- Bureau of Meteorology (Chair and Secretariat)
- Northern Territory Emergency Service
- Northern Territory Department of Environment and Natural Resources

---

<sup>64</sup> Northern Territory Service Level Specification document: <http://www.bom.gov.au/nt/flood/brochures/NT-Service-Level-Specification.pdf>

- Local Government Association of Northern Territory
- Northern Territory Department of the Chief Minister (Security and Emergency Recovery)

## Appendix 8 – Flood Warning Arrangements in Western Australia

### Flood Risk Management and Emergency Management in Western Australia

The Department of Water and Environmental Regulation is responsible for the development of a floodplain management strategy for Western Australia and the Department of Fire and Emergency Services (DFES) is designated as Hazard Management Agency (HMA) for flood within Western Australia (Emergency Management Regulations 2006). Planning for flood emergencies is undertaken in compliance with the Emergency Management Act 2005. WESTPLAN-FLOOD (State Hazard Plan for Flood<sup>65</sup>) details the emergency management arrangements for potential or actual floods in Western Australia. This includes details of the roles and responsibilities of participating organisations in managing floods in Western Australia.

### Operating Arrangements

#### Flood Monitoring and Prediction

The Bureau of Meteorology has responsibility for flood monitoring and prediction in Western Australia. This includes the dissemination of flood forecasts and warnings of minor, moderate or major flooding throughout the period of flooding. These forecasts and warnings are disseminated to State and local agencies and the media in accordance with the service levels as set out in the Service Level Specification for Western Australia (see 8.3.1). Flood Watches and Flood Warnings are published on the Bureau website along with rainfall and river level data for catchments covered by the service.

#### Interpretation

Bureau flood forecasts and warnings are issued to response agencies, in particular to the Department of Fire and Emergency Services and local councils. These agencies are responsible for further interpretation of Bureau flood predictions into local impacts. This interpretation is aided by local flood intelligence including available flood mapping where available. Main Roads Western Australia provides advice in particular on potential flooding impacts on the road system, including advice on alternate routes when major routes have been cut by flooding. The Department of Water and Environmental Regulation assists with local interpretation of flood impacts and may undertake flood modelling for this purpose.

#### Establishment of Flood Class Levels

---

<sup>65</sup> State Hazard Plan for Flood (WESTPLAN - FLOOD) (2016): <https://www.oem.wa.gov.au/Documents/Resources/LegislationPolicyPlansProcedureandGuidelines/Plans/Westplans2016/WestplanFloodSEMCapproved24052016.pdf>

The Bureau of Meteorology collaborates with local councils, Department of Water and Environmental Regulation and the Department of Fire and Emergency Services in the establishment of flood class levels<sup>66</sup>.

### Warning Dissemination

The Bureau of Meteorology prepares and disseminates Flood Watch and Flood Warning messages from the State and Territory Forecasting Centres. The Department of Fire and Emergency Services assists with the dissemination of Flood Watch and Flood Warning information and flood advice to the community; further assisted by Western Australia Police.

### Generating Flood Response Behaviour

The prime responsibility for implementing and operating flood alerting procedures for communities rests with the Department of Fire and Emergency Services and Western Australia Police. Police (and local authorities where appropriate) assist in facilitating appropriate response actions at the local level. The Department of Fire and Emergency Services, in cooperation with other agencies, provide communities with flood risk awareness, information and education.

Individuals can be directly alerted through the Emergency Alert (Emergency Alert Website<sup>67</sup>) system, which is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a defined area about likely or actual emergencies including floods. The Standard Emergency Warning Signal (SEWS)<sup>68</sup> may also be used.

### Community Information

Information and support to individuals and communities is available State-wide at: DFES - Flood Website<sup>69</sup>. Advice to individuals on what to do before, during and after a flood is at: Emergency Management Australia Guide<sup>70</sup>.

### Consultation and Coordination during Floods

In order to assist flood forecasting, the State Forecasting Centre may consult with the Flood Warning Operational Group (FWOG) members or activate the FWOG as it deems appropriate. The roles and responsibilities of the FWOG are outlined in the WESTPLAN – FLOOD document and is comprised of the following representatives:

- Bureau of Meteorology (Chair and Secretariat)
- Main Roads Western Australia

---

<sup>66</sup> Details of flood class levels can be found in the main body of the document.

<sup>67</sup> Emergency Alert Website: <http://www.emergencyalert.gov.au/>

<sup>68</sup> Standard Emergency Warning Signal (SEWS): <https://www.dfes.wa.gov.au/safetyinformation/warningsystems/pages/sews.aspx>

<sup>69</sup> DFES Flood Website: <http://www.dfes.wa.gov.au/safetyinformation/flood/Pages/default.aspx>

<sup>70</sup> Emergency Management Australia Guide for "What to do before, during and after a flood?" (Attorney General's Department, 2005): [http://www.bom.gov.au/water/floods/document/What\\_todo\\_floods.pdf](http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf)

- Department of Water and Environmental Regulation
- Water Corporation; and
- Other agencies selected by the Chair

The composition of the FWOG can be varied depending on the nature of the event, technical expertise requirements and resource needs. The duration of FWOG meetings will vary with the level and immediacy of the emergency and the requirements of DFES. Agencies may be requested to provide personnel to cover multiple shifts within the constraints of each agency's available resources and commitments.

### Formal Service Level and Data Provision

#### Service Level Specification

The Service Level Specification for Western Australia describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of Meteorology in Western Australia. This specification can be found at: Western Australia Service Level Specification<sup>71</sup>

#### Data Sharing Agreement

The Data Sharing Agreements in place or under development for supporting flood forecasting and warning services in Western Australia are between the Bureau of Meteorology and:

- Department of Water and Environmental Regulation
- Department of Biodiversity, Conservation and Attractions (formerly DPaW)
- Department of Primary Industries and Regional Development (formerly DAFWA)

### Systems Maintenance and Support

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the data sharing agreements for flood warning data collection. Each data sharing agreement includes arrangements for emergency callouts for network maintenance in times of flooding.

The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

### Service Planning and Coordination

---

<sup>71</sup> Western Australia Service Level Specification document: [http://www.bom.gov.au/wa/flood/SLS\\_flood-warnings\\_WA.pdf](http://www.bom.gov.au/wa/flood/SLS_flood-warnings_WA.pdf)

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. This requires that the agencies establish and maintain arrangements outside of flood times and the primary means of achieving such coordination among agencies involved in the Total Flood Warning System in Western Australia is the Flood Warning Consultative Committee. Membership of the Western Australia Flood Warning Consultative Committee is:

- Bureau of Meteorology (Chair and Secretariat)
- Department of Fire and Emergency Services
- Department of Water and Environmental Regulation
- Western Australia Local Government Association
- Main Roads Western Australia
- Office of Emergency Management
- Water Corporation of Western Australia
- Landgate (Satellite Remote Sensing Service)
- Department of Housing (Planning and Programs Aboriginal Housing)
- Department of Primary Industries and Regional Development (formerly DAFWA)
- Department of Planning
- Other organisations as seconded by the Chair

## Appendix 9 – Flood Warning Arrangements in South Australia

### Flood Risk Management and Emergency Management in South Australia

Flood warning services in South Australia operate within the context of State and regional policies and strategies for flood risk and emergency management. These strategies guide the actions of State, regional and local agency partners in the overall management of flood risk and flood events in the State. All emergency management arrangements in South Australia are governed by the Emergency Management Act (2004). Relevant authorities, responsibilities and mechanisms are set out in the State Emergency Management Plan. This includes the appointment of a Hazard Leader as the agency to undertake a leadership role for the planning of emergency management activities pertaining to the prevention of, preparedness for, response to and recovery from the designated hazard. The Hazard Leader for flood is the Department of Environment, Water and Natural Resources (DEWNR).

The specific responsibilities of agencies at each level of government in providing flood forecasting and warning services in South Australia are summarised below.

### Operating Arrangements

#### Flood Monitoring and Prediction

The Bureau of Meteorology has responsibility for flood monitoring and prediction for areas of South Australia as outlined in the Service Level Specification for South Australia. The Bureau is responsible for the dissemination of flood forecasts and warnings of minor, moderate or major flooding throughout the period of flooding for the specified forecast locations in the Service Level Specification for South Australia.

Flood warning services for the Lower Murray River are the responsibility of the Department of Environment, Water and Natural Resources (DEWNR)<sup>72</sup>.

These forecasts and warnings are disseminated to State and local agencies and the media in accordance with the service levels as set out in the Service Level Specification for South Australia. Flood Watches and Flood Warnings are published on the Bureau website along with rainfall and river level data for catchments covered by the service.

#### Interpretation

Bureau flood forecasts and warnings are issued to South Australian State Emergency Service (SASES) as the control agency and to response agencies including South Australia Police (SAPOL),

---

<sup>72</sup> Action is underway to transition forecasting services for the Lower Murray into the Bureau.

and local councils. These agencies may provide further interpretation of Bureau flood predictions into local impacts. This interpretation is aided by local flood intelligence.

### **Establishment of Flood Class Levels**

The need to review or establish a new Flood Class Level<sup>73</sup> at a locality may be identified by the Bureau of Meteorology, South Australian State Emergency Service, a local council or a State agency. The levels are established from local information informed by flood studies and flood emergency plans as available to best match the definitions of each classification. The levels are submitted to the South Australian Flood Warning Consultative Committee for final endorsement and then submitted to the Bureau (and other agencies) for inclusion in forecast and warning procedures.

### **Warning Dissemination**

The Bureau is the responsible agency for the issuing of warnings and information, relating to the onset and progress of flood events, directly to South Australian State Emergency Service, South Australian Police, the Department of Environment, Water and Natural Resources (as Flood Hazard Leader), SA Water and local government authorities. It is the responsibility of the State Emergency Service and South Australia Police to immediately pass the information to their relevant Regional and Local Service Area commanders and officers and others as deemed appropriate.

The Bureau is also the issuing authority for Flood Watch and Flood Warning products to the general public and the media.

### **Generating Flood Response Behaviour**

The prime responsibility for implementing and operating flood response procedures for communities rests with the South Australian State Emergency Service and, where appropriate, Police and local authorities. Community education about flooding is vital for people in and surrounding flood affected areas and is primarily the responsibility of the State Emergency Service. Individuals can be directly alerted through the Emergency Alert (Emergency Alert Website<sup>74</sup>) system, which is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a defined area about likely or actual emergencies including floods. The Standard Emergency Warning Signal (SEWS)<sup>75</sup> may also be used.

### **Community Information**

---

<sup>73</sup> Details of Flood Class Levels can be found in the main body of the document.

<sup>74</sup> Emergency Alert Website: <http://www.emergencyalert.gov.au/>

<sup>75</sup> Standard Emergency Warning Signal (SEWS): <http://www.emergencyalert.gov.au/frequently-asked-questions/what-is-emergency-alert/75-3-what-is-the-standard-emergency-warning-signal.html>

Information and support to individuals and communities is available through the South Australian State Emergency Service - Flood Information<sup>76</sup> as well as through local councils. Advice to individuals on what to do before, during and after a flood is at: Emergency Management Australia Guide<sup>77</sup>

### Consultation and Coordination during Floods

The Control Agency for floods in South Australia is the State Emergency Service. Their role is to take control of a flood incident and assume responsibility for tasking other organisations in accordance with the needs of the situation.

The South Australian State Emergency Service and South Australia Police maintain regular contact with the Bureau following the issuing of a Flood Watch or Flood Warning. Continuing liaison is aimed at ensuring that flood information is available for application by these organisations and other agencies (e.g. Country Fire Service, Department of Environment, Water and Natural Resources, Department of Planning, Transport and Infrastructure etc.).

## Formal Service Level and Data Provision

### Service Level Specification

The Service Level Specification for South Australia describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of Meteorology in South Australia. This specification has been formally agreed between the Bureau and other stakeholders as represented by the Flood Warning Consultative Committee and can be found at: South Australia Service Level Specification<sup>78</sup>

### Data Sharing Agreement

The Data Sharing Agreements in place or under development for supporting flood forecasting and warning services in SA are between the Bureau of Meteorology and:

- SA Water
- Department of Environment, Water and Natural Resources (DEWNR)

## Systems Maintenance and Support

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the Data Sharing Agreements for flood warning data collection. Each Data Sharing Agreement includes arrangements for emergency callouts for network maintenance in times of flooding.

<sup>76</sup> South Australian State Emergency Service – Flood Information: <http://www.ses.sa.gov.au/site/home.jsp>

<sup>77</sup> Emergency Management Australia Guide for “What to do before, during and after a flood?” (Attorney Generals Department, 2005, [http://www.bom.gov.au/water/floods/document/What\\_todo\\_floods.pdf](http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf))

<sup>78</sup> South Australia Service Level Specification document: [http://www.bom.gov.au/sa/flood/SA\\_SLS\\_current.pdf](http://www.bom.gov.au/sa/flood/SA_SLS_current.pdf)

The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

### **Service Planning and Coordination**

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. This requires that the agencies establish and maintain arrangements outside of flood times and a primary means of achieving such coordination among agencies involved in the Total Flood Warning System in South Australia is the Flood Warning Consultative Committee. Membership of the South Australian Flood Warning Consultative Committee is:

- Bureau of Meteorology (Chair and Secretariat)
- South Australian State Emergency Service
- South Australia Police
- Department of Environment, Water and Natural Resources (DEWNR) including the Flood Hazard Leader
- SA Water
- Department of Planning, Transport and Infrastructure
- Local Government Association
- South Australian Fire and Emergency Services Commission (SAFECOM)

The Flood Hazard Leader has strategic responsibility for flood risk management in South Australia. The South Australian emergency management arrangements identify the Department of Environment, Water and Natural Resources (DEWNR) as the Flood Hazard Leader.

## Appendix 10 – Flood Warning Arrangements in Tasmania

### Flood Risk Management and Emergency Management in Tasmania

Flood warning services in Tasmania operate within the context of State and regional policies and strategies for flood risk and emergency management, as these strategies guide the actions of State, regional and local agency partners in the overall management of flood risk in the State.

Emergency management arrangements in Tasmania are founded in the Emergency Management Act 2006. The framework for all hazard arrangements is set by the Tasmanian Emergency Management Plan<sup>79</sup>. More specific arrangements are set in supporting emergency plans for specific hazards or functions. Emergency management activities are overseen by the State, Regional and Municipal Emergency Management Committees and their sub-committees. The membership and main functions of these committees are set out in the Tasmanian Emergency Management Plan (TEMP)<sup>80</sup>.

Specific arrangements for flood hazards are set out in the Tasmanian Flood State Special Emergency Management Plan<sup>81</sup>. The plan details and documents the roles and responsibilities associated with the management of flood risks in Tasmania and covers various flood hazards; riverine, flash, dam safety emergencies, storm surge and underground karst systems. Tsunamis are not covered.

At regional and municipal levels, Regional Emergency Management Committees and Municipal Emergency Management Committees manage flood related risks in accordance with the Emergency Management Act 2006, TEMP, Regional Emergency Management Plans (REMPs), Municipal Emergency Management Plans (MEMPs) and Flood State Special Emergency Management Plan.

Flood related risks and treatments are included in Municipal level risk registers with treatments being implemented by a range of stakeholders including Municipal Councils and SES. Municipal Councils work in partnership with SES and other stakeholders, including Hydro Tasmania, to undertake flood studies and floodplain studies to inform floodplain risk management decision making.

The Floodplain Risk Assessment Guidelines for Municipal Councils in Tasmania<sup>82</sup> summarises a method for the assessment of floodplain risks in Tasmania consistent with NERAG<sup>83</sup> and AIDR Handbook 7. Municipal Councils and Municipal Emergency Management Committees who face significant flood risks are encouraged to follow these guidelines when undertaking flood hazard studies into the future.

---

<sup>79</sup> Tasmanian Emergency Management Plan: [http://www.ses.tas.gov.au/assets/files/Plans/State/Tasmanian\\_Emergency\\_Management\\_Plan\\_-\\_Issue\\_8.pdf](http://www.ses.tas.gov.au/assets/files/Plans/State/Tasmanian_Emergency_Management_Plan_-_Issue_8.pdf)

<sup>80</sup> Tasmanian Emergency Management Plan: [http://www.ses.tas.gov.au/assets/files/Plans/State/Tasmanian\\_Emergency\\_Management\\_Plan\\_-\\_Issue\\_8.pdf](http://www.ses.tas.gov.au/assets/files/Plans/State/Tasmanian_Emergency_Management_Plan_-_Issue_8.pdf)

<sup>81</sup> Tasmania Flood State Special Emergency Management Plan, Issue 1, 2017

<sup>82</sup> Floodplain Risk Assessment Guidelines for Municipal Councils in Tasmania: [http://www.ses.tas.gov.au/assets/files/EM\\_Publications/FRAPT\\_2016\\_Floodplain\\_Risk\\_Assess\\_11\\_Nov\\_2016\\_low\\_res\\_ART.pdf](http://www.ses.tas.gov.au/assets/files/EM_Publications/FRAPT_2016_Floodplain_Risk_Assess_11_Nov_2016_low_res_ART.pdf)

<sup>83</sup> NERAG – National Emergency Risk Assessment Guidelines (AIDR 2015) <https://knowledge.aidr.org.au/media/2030/handbook-10-national-emergency-risk-assessment-guidelines.pdf>

The specific responsibilities of agencies at each level of government in providing flood forecasting and warning services in Tasmania are summarised below.

## Operating Arrangements

### Flood Monitoring and Prediction

The Bureau monitors rainfall and river height observations from a range of sources, including sites owned by the Bureau, DPIPWE, Hydro Tasmania, Tasmanian Irrigation, Huon Valley Council and Derwent Valley Council as detailed in the Service Level Specification and Data Sharing Agreements. The Bureau uses observational and forecast data in hydrological models to forecast the timing and magnitude of riverine peak heights and/or flood level classifications for a number of forecast locations as detailed in the Service Level Specification. The Bureau undertakes its prediction activities in close coordination with Hydro Tasmania in their role in operating the Tasmanian hydro-power system.

The Bureau disseminates flood forecasts and warnings of minor, moderate or major flooding for catchments with a flood warning service. These forecasts and warnings are disseminated to State and local agencies and the media in accordance with the service levels as set out in the Service Level Specification for Tasmania. Flood Watches and Flood Warnings are published on the Bureau website, along with rainfall and river level data for catchments covered by the service. In Tasmania, the Bureau also issues River and Rainfall Alerts to registered local stakeholders when river and rainfall conditions exceed agreed threshold levels. This alerting service<sup>84</sup> is provided on behalf of State Emergency Services Tasmania.

Launceston City Council operates a flood forecasting system for the South Esk, North Esk and Tamar Rivers for Launceston. The Council and the Northern REMC maintain a number of plans that specify roles and responsibilities of the Council and other parties for the interpretation and utilization of monitoring data from the forecasting system.

Hobart City and Glenorchy City councils own and operate Automated Local Evaluation in Real Time (ALERT) rainfall and river height systems for internal council flash flood response purposes.

### Interpretation

A function of the State Emergency Service Tasmania Incident Management Teams is to provide timely and accurate public information in order to protect and reassure the community. The Bureau of Meteorology and SES issue a range of complementary flood warning products that form part of the Tasmanian Total Flood Warning System.

The State Emergency Service Tasmania interprets Bureau flood warnings and a range of forecast and observational data, considers advice from relevant experts, and considers guidance and information contained in relevant operational plans and flood intelligence cards. SES has access to flood

---

<sup>84</sup> Arrangements for this service are being reviewed as part of standardisation of services.

evacuation plans, flood studies and associated flood maps to inform decision making and to estimate impacts at the local level. State legislation requires local government to develop Emergency Management Plans. These can include the development of flood maps and plans and standard operating procedures during floods.

### **Establishment of Flood Class Levels**

The need to review or establish a new Flood Class Level<sup>85</sup> at a locality is identified by consultation between the Bureau of Meteorology, State Emergency Service Tasmania, local councils and the Department of Primary Industries, Parks, Water and Environment. The levels are established from local information informed by flood studies and flood emergency plans as available to best match the definitions of each classification. The levels are submitted to the Tasmania Flood Warning Consultative Committee for final endorsement and then submitted to the Bureau (and other agencies) for inclusion in forecast and warning procedures.

### **Warning Dissemination**

The responsibility for disseminating warnings and related information to the communities at risk at the onset or during periods of flooding rests in the main with the Bureau of Meteorology and State Emergency Service Tasmania. The Bureau disseminates flood warnings through its website, the media and direct to emergency agencies.

Emergency agencies provide localised interpretation and further disseminate Bureau warnings to local government and relevant regional authorities for dissemination in their community in accordance with agency responsibilities and specific local arrangements in the respective local flood plans.

Department of Premier and Cabinet maintains the all hazards TasAlert capability that is the official online source of emergency information and advice, including replication of Bureau warnings. Flood warning messages issued by the SES can also be disseminated by a variety of methods, depending on severity and urgency. These include SES and TasAlert online platforms, media briefings, Emergency Alert, call centre, and door-to-door.

### **Generating Flood Response Behaviour**

A critical part of any flood warning system is the prompt alerting of the community that flooding will occur. This alerting must be able to operate at any time and is usually through a variety of means. The prime responsibility for implementing and operating flood alerting procedures for communities rests with local government and State Emergency Service Tasmania. Local government has responsibility for actions at a local level in order to respond to the flood.

Community education about flooding is vital for people in and surrounding flood affected areas. This education is paramount to the community's effective response. Responsibility for education is primarily

---

<sup>85</sup> Details of Flood Class Levels can be found in the main body of the document.

a local government and State Emergency Service Tasmania responsibility. The Tasmania Flood Warning Consultative Committee provides assistance where required.

Individuals can be directly alerted through the Emergency Alert (Emergency Alert Website<sup>86</sup>) system, which is the national telephone warning system used to send voice messages to landlines and text messages to mobile phones within a defined area about likely or actual emergencies including floods. The Standard Emergency Warning Signal (SEWS)<sup>87</sup> may also be used on radio and television. SES also maintains the Invermay Flood Evacuation Siren.

### Community Information

Information and support to individuals and communities is available state-wide through State Emergency Service Tasmania at: Tasmanian State Emergency Service -Floodsafe<sup>88</sup>.

Advice to individuals on what to do before, during and after a flood is at: Emergency Management Australia Guide<sup>89</sup>.

A summary of the history of flooding in Tasmania is available at Tasmanian FloodHistory<sup>90</sup>

### Consultation and Coordination during Floods

The Bureau of Meteorology maintains close contact with the State Emergency Service Tasmania at all operational levels during floods to assist with interpreting flood predictions and related flood operational matters. The Bureau of Meteorology maintains regular contact with Launceston City Council, Northern Midlands Council and Huon Valley Council during flood operations. The Bureau of Meteorology also coordinates closely with Hydro Tasmania in their role in operating the Tasmanian hydro-power system during flood operations.

## Formal Service Level and Data Provision

### Service Level Specification

The Service Level Specification for Tasmania describes the flood forecasting and warning services and associated target performance levels as provided by the Bureau of Meteorology in Tasmania. This specification can be found at: Tasmania Service Level Specification<sup>91</sup>

### Data Sharing Agreement

The Data Sharing Agreements in place or under development for supporting flood forecasting and warning services in Tasmania are between the Bureau of Meteorology and:

---

<sup>86</sup> Emergency Alert Website: <http://www.emergencyalert.gov.au/>

<sup>87</sup> Standard Emergency Warning Signal (SEWS): <http://www.ses.tas.gov.au/h/em/awareness/sews>

<sup>88</sup> Tasmanian State Emergency Service Floodsafe website: <http://www.ses.tas.gov.au/h/em/awareness/flood/floodsafe1>

<sup>89</sup> Emergency Management Australia Guide for "What to do before, during and after a flood?" (Attorney Generals Department, 2005, [http://www.bom.gov.au/water/floods/document/What\\_todo\\_floods.pdf](http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf)

<sup>90</sup> Tasmanian Flood History website: [http://www.bom.gov.au/tas/flood/flood\\_history/flood\\_history.shtml](http://www.bom.gov.au/tas/flood/flood_history/flood_history.shtml)

<sup>91</sup> Tasmanian Service Level Specification: [http://www.bom.gov.au/tas/flood/TAS\\_SLS\\_Current.pdf](http://www.bom.gov.au/tas/flood/TAS_SLS_Current.pdf)

- Hydro Tasmania;
- Department of Primary Industries, Parks, Water and Environment;
- CSIRO

### **Systems Maintenance and Support**

The arrangements for the ongoing maintenance and support of the data collection networks are in accordance with responsibilities as set out in the Data Sharing Agreements for flood warning data collection. Each Data Sharing Agreement includes arrangements for emergency callouts for network maintenance in times of flooding.

The Bureau of Meteorology is responsible for maintaining the currency of the operational flood forecasting system, including the real-time data ingestion system. This includes updating the calibration of forecasting models as new data and other information becomes available and for continuing improvement to the efficiency of operational processes.

### **Service Planning and Coordination**

The effective operation of the Total Flood Warning System requires that the agencies involved work smoothly together during floods. This requires that the agencies establish and maintain arrangements outside of flood times.

The Tasmanian Flood Warning Consultative Committee (TFWCC) coordinates the development and operation of flood forecasting and warning services in Tasmania and acts as an advisory body to the Bureau and participating State and local government agencies. Membership of the Tasmania Flood Warning Consultative Committee is:

- Bureau of Meteorology (Chair and Secretariat)
- State Emergency Services
- Tasmanian Farmers and Graziers Association
- Hydro Tasmania
- Department of Primary Industries, Parks, Water and Environment (DPIPWE)
- Launceston City Council
- Northern Midlands Council
- Huon Valley Council
- Central Coast Council
- Kentish Council
- Local Government Association of Tasmania
- Tas Water

The Tasmanian Consultative Committee on Severe Weather Services (TCCSWS) provides a forum for stakeholders, including emergency services, to advise the Bureau on their requirements for severe weather services. Severe weather services relevant to flood management include warnings for heavy rainfall that may lead to flash flooding and warnings for abnormally high tides.

## Appendix 11 – References

### Online Documents

Intergovernmental Agreement: <https://www.coag.gov.au/about-coag/agreements/intergovernmental-agreement-provision-bureau-meteorology-hazard-services>

Insurance Contracts Regulations 1985 s29D: <https://www.legislation.gov.au/Details/F2015C00353>

Review of the Bureau of Meteorology's capacity to respond to future extreme weather and natural disaster events and to provide seasonal forecasting. Chloe Munro (2011).: <http://www.environment.gov.au/resource/review-bureau-meteorologys-extreme-weather-and-seasonal-forecasting-capacity>

Australian Emergency Management Arrangements (AIDR 2014) <https://knowledge.aidr.org.au/resources/handbook-9-australian-emergency-management-arrangements/>

Manual 21 *Flood Warning* (AIDR, 2009) <https://knowledge.aidr.org.au/media/1964/manual-21-flood-warning.pdf>

Manual 20 *Flood Preparedness* (AIDR 2009) <https://knowledge.aidr.org.au/media/1963/manual-20-flood-preparedness.pdf>

National Strategy for Disaster Resilience: <https://www.ag.gov.au/EmergencyManagement/Documents/NationalStrategyforDisasterResilience.PDF>

AIDR 2017. *Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia.* <https://knowledge.aidr.org.au/resources/handbook-7-managing-the-floodplain/>

"*Choosing your Words*" (Attorney-General's Department, 2008) <https://www.ag.gov.au/Publications/Pages/Emergency-warnings-choosing-your-words.aspx>

Victorian Department of Environment, Land, Water and Planning Floodplain Management Strategy: <https://www.water.vic.gov.au/managing-floodplains/new-victorian-floodplain-management-strategy>

VICSES Emergency Plans: <https://www.ses.vic.gov.au/em-sector/vicses-emergency-plans>

Emergency Management Victoria – Emergency Management Manual <https://www.emv.vic.gov.au/policies/emmv>

Emergency Management Australia Guide for "*What to do before, during and after a flood?*" (Attorney Generals Department, 2005, [http://www.bom.gov.au/water/floods/document/What\\_todo\\_floods.pdf](http://www.bom.gov.au/water/floods/document/What_todo_floods.pdf)

Victorian Service Level Specification document: [http://www.bom.gov.au/vic/flood/brochures/VIC\\_SLS\\_current.pdf](http://www.bom.gov.au/vic/flood/brochures/VIC_SLS_current.pdf)

New South Wales State Flood Sub Plan (March 2018): <https://www.emergency.nsw.gov.au/Documents/plans/sub-plans/SubPlan-Flood.pdf>

Floodplain Development Manual: <https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Water/Floodplains/floodplain-development-manual.pdf>

New South Wales and Australian Capital Territory Service Level Specification: [http://www.bom.gov.au/nsw/NSW\\_SLS\\_Current.pdf](http://www.bom.gov.au/nsw/NSW_SLS_Current.pdf)

<https://www.disaster.qld.gov.au/cdmp/Documents/Queensland-State-Disaster-Management-Plan.pdf>

Queensland Service Level Specification document:  
[http://www.bom.gov.au/qld/flood/brochures/QLD\\_SLS\\_current.pdf](http://www.bom.gov.au/qld/flood/brochures/QLD_SLS_current.pdf)

Northern Territory Service Level Specification document: <http://www.bom.gov.au/nt/flood/brochures/NT-Service-Level-Specification.pdf>

State Hazard Plan for Flood (WESTPLAN - FLOOD) (2016):  
<https://www.oem.wa.gov.au/Documents/Resources/LegislationPolicyPlansProcedureandGuidelines/Plans/Westplans2016/WestplanFloodSEMCApproved24052016.pdf>

Western Australia Service Level Specification document: [http://www.bom.gov.au/wa/flood/SLS\\_flood-warnings\\_WA.pdf](http://www.bom.gov.au/wa/flood/SLS_flood-warnings_WA.pdf)

South Australia Service Level Specification document:  
[http://www.bom.gov.au/sa/flood/SA\\_SLS\\_current.pdf](http://www.bom.gov.au/sa/flood/SA_SLS_current.pdf)

Tasmanian Emergency Management Plan:  
[http://www.ses.tas.gov.au/assets/files/Plans/State/Tasmanian\\_Emergency\\_Management\\_Plan\\_-\\_Issue\\_8.pdf](http://www.ses.tas.gov.au/assets/files/Plans/State/Tasmanian_Emergency_Management_Plan_-_Issue_8.pdf)

Floodplain Risk Assessment Guidelines for Municipal Councils in Tasmania:  
[http://www.ses.tas.gov.au/assets/files/EM\\_Publications/FRAPT\\_2016\\_Floodplain\\_Risk\\_Assess\\_11\\_Nov\\_2016\\_low\\_res\\_ART.pdf](http://www.ses.tas.gov.au/assets/files/EM_Publications/FRAPT_2016_Floodplain_Risk_Assess_11_Nov_2016_low_res_ART.pdf)

NERAG – National Emergency Risk Assessment Guidelines (AIDR 2015,  
<https://knowledge.aidr.org.au/media/2030/handbook-10-national-emergency-risk-assessment-guidelines.pdf>

Tasmanian Service Level Specification: [http://www.bom.gov.au/tas/flood/TAS\\_SLS\\_Current.pdf](http://www.bom.gov.au/tas/flood/TAS_SLS_Current.pdf)

## **Websites**

Bureau of Meteorology website: <http://www.bom.gov.au/>

Queensland Flood Commission website: <http://www.floodcommission.qld.gov.au>

Victorian Flood Review website: <http://www.floodsreview.vic.gov.au>

Tasmania Flood Review Website: [http://www.dpac.tas.gov.au/government\\_flood\\_review](http://www.dpac.tas.gov.au/government_flood_review)

Victorian Regional Floodplain Management Strategies: <https://www.water.vic.gov.au/managing-floodplains/regional-floodplain-management-strategies>

NSW Flood Data Access: <https://www.ses.nsw.gov.au/flood-resources/nsw-flood-data-access/nsw-flood-data-access/>

Geoscience Australia – Australian Flood Risk Information Portal: <http://www.ga.gov.au/flood-study-web/#/search>

Emergency Alert Website: <http://www.emergencyalert.gov.au/>

SEWS – Standard Emergency Warning Signal (VIC):  
[http://www.police.vic.gov.au/content.asp?Document\\_ID=23388](http://www.police.vic.gov.au/content.asp?Document_ID=23388)

Victorian State Emergency Service Floodsafe website: <https://www.ses.vic.gov.au/get-ready/floodsafe>

Victorian State Emergency Local Flood Guides website: <https://www.ses.vic.gov.au/get-ready/your-local-flood-information>

Flood Victoria website: <http://www.floodvictoria.vic.gov.au/>

Floodplain Managements Grant Program: <https://www.environment.nsw.gov.au/coasts/Floodgrants.htm>

Emergency Alert Website: <http://www.emergencyalert.gov.au/>

Standard Emergency Warning Signal (SEWS) (NSW): <https://www.emergency.nsw.gov.au/Pages/for-the-community/alert-NSW/SEWS.aspx>

New South Wales State Emergency Service Floodsafe website: <http://www.floodsafe.com.au/>

Queensland Disaster Management Arrangements: <https://www.disaster.qld.gov.au/dmg/Pages/DM-Guideline.aspx>

Standard Emergency Warning Signal (SEWS) (QLD):  
<https://www.disaster.qld.gov.au/dmg/Response/Pages/5-6.aspx>

Get Ready Queensland (floods): <https://getready.qld.gov.au/natural-disasters/flood/>

Sunwater: <http://www.sunwater.com.au/community/living-near-dams>

Seqwater: <http://www.seqwater.com.au/dam-release-information-service>

<http://www.disaster.qld.gov.au/Disaster-Resources/dmreview/Pages/Seqwater-Sunwater-warnings.aspx>

Standard Emergency Warning Signal (SEWS): <http://www.emergencyalert.gov.au/frequently-asked-questions/what-is-emergency-alert/75-3-what-is-the-standard-emergency-warning-signal.html>

Northern Territory Emergency Service Floods website: <http://www.pfes.nt.gov.au/Emergency-Service/Public-safety-advice/Floods.aspx>

Standard Emergency Warning Signal (SEWS) (WA):  
<https://www.dfes.wa.gov.au/safetyinformation/warningsystems/pages/sews.aspx>

DFES Flood Website: <http://www.dfes.wa.gov.au/safetyinformation/flood/Pages/default.aspx>

South Australian State Emergency Service – Flood Information: <http://www.ses.sa.gov.au/site/home.jsp>

Tasmanian State Emergency Service Floodsafe website:  
<http://www.ses.tas.gov.au/h/em/awareness/flood/floodsafe1>

Standard Emergency Warning Signal (SEWS) (TAS): <http://www.ses.tas.gov.au/h/em/awareness/sews>

Tasmanian Flood History website: [http://www.bom.gov.au/tas/flood/flood\\_history/flood\\_history.shtml](http://www.bom.gov.au/tas/flood/flood_history/flood_history.shtml)