

Draft Victorian Floodplain Management Strategy



© The State of Victoria Department of Environment and Primary Industries 2014



This work is licensed under a Creative Commons Attribution 3.0 Australia licence. You are free to re-use the work under that licence, on the condition that you credit the State of Victoria as author. The licence does not apply to any images, photographs or branding, including the Victorian Coat of Arms, the Victorian Government logo and the Department of Environment and Primary Industries logo. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/3.0/au/deed.en>

Printed by Impact Digital, Brunswick

ISBN 978-1-74146-023-0 (Print) ISBN 978-1-74146-024-7 (pdf).

Accessibility

If you would like to receive this publication in an alternative format, please telephone the DEPI Customer Service Centre on 136186, email customer.service@depi.vic.gov.au or via the National Relay Service on 133 677 www.relayservice.com.au. This document is also available on the internet at www.depi.vic.gov.au

Disclaimer

This publication may be of assistance to you but the State of Victoria and its employees do not guarantee that the publication is without flaw of any kind or is wholly appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on any information in this publication.

Foreword

Improving Victoria's planning and preparation for flood will make communities safer and minimise flood emergencies. This new approach acknowledges that, while flooding may be inevitable, its impact can be minimised by better application of land use planning tools, an improved flood warning system and clarity around roles and responsibilities.

The draft *Victorian Floodplain Management Strategy* represents decisive and innovative action by the Victorian Coalition Government in response to the flood emergencies that followed record rainfall across Victoria in 2010-11.

The draft strategy supports the initiatives already begun by the Government to assist communities, including:

- developing technologies to improve mapping of flood risks and warning communities
- funding and implementing more local flood studies
- facilitating opportunities for landholders to access public land and manage flood protection levees.

The draft strategy was developed with significant input from an Interdepartmental Stakeholder Reference Group, which worked with Catchment Management Authorities, Melbourne Water, Goulburn-Murray Water, Victorian State Emergency Service, Bureau of Meteorology, local government and other key stakeholders to prepare the draft strategy and set the policy direction.

The strategy moves away from the traditional approach of focusing on flood response to focus on prevention and mitigation efforts that:

- improve the quality of information available for floodplain management decisions
- clarify responsibilities for floodplain management, emergency management and environmental management
- ensure communities can access and act on high-quality flood risk information
- ensure the benefits of floodplain management measures outweigh the costs.

The draft strategy supports setting priorities at regional level, through regional floodplain management strategies developed in consultation with local communities. These strategies will help empower communities to take action to manage their own flood risks.

The next important stage of this partnership is to seek feedback from the community to ensure that the strategy provides clarity around roles and responsibilities, allowing for decisive action, with a focus on communities reducing the consequences of flood through increased mitigation efforts.

I encourage you to read the draft strategy and contribute your views.

*Chair of the Interdepartmental Stakeholder Reference Group
(Sharyon Peart)*



A handwritten signature in black ink that reads "Sharyon Peart".

Let us know what you think

Your views on the draft strategy are sought

Submissions on the draft strategy are invited. Please make your submission by 5pm on Monday 11 August 2014 by post or email to:

Department of Environment and Primary Industries

Sustainable Water and Environments

PO Box 500

East Melbourne VIC 3002

Phone: 136 186

Email: VFMS.Inquiry@depi.vic.gov.au

(If emailing, please supply postal address details)

Electronic copies of the draft strategy and other supporting material are available online at www.vic.gov.au/floodplainmanagementstrategy. If you would like printed copies or have any questions about the draft strategy, please contact the project team on the details above.

You need to know

The information you provide in your submission, or any other response, will be used by the Department of Environment and Primary Industries only in the development of the Victorian Floodplain Management Strategy. It may be disclosed to the project inter-departmental stakeholder reference group and other relevant agencies as part of the consultation process.

All submissions will be acknowledged and treated as public documents and will be published on the internet for public access.

All addresses, phone numbers and email details will be removed before submissions are published on the internet. Formal requests for confidentiality will be honoured but Freedom of Information access requirements will apply to submissions treated as confidential.

If you wish to access information in your submission once it is lodged with the Department, you may contact the Victorian Floodplain Management Strategy Project Team at the above address.

Unless otherwise indicated, individuals who provide a submission will receive a copy of the final Victorian Floodplain Management Strategy.

Next steps

Submissions will be considered, along with additional stakeholder contributions, by the Interdepartmental Stakeholder Reference Group, as part of the development of the final strategy. The department will continue, as appropriate, to discuss the policy direction with targeted stakeholders such as Indigenous groups, local councils and Catchment Management Authorities as part of the development of the final strategy. The final strategy is expected to be released by the end of 2014.

Planning for implementation of the final strategy

The draft strategy identifies a number of proposed actions, policies and accountabilities to clarify roles and responsibilities in floodplain management in Victoria and enable communities and businesses to manage their flood risk. These activities will be implemented on a priority basis as funding becomes available. The proposed actions will be finalised based on consideration of stakeholder input on the draft strategy. The final strategy will provide details on the timelines for delivering the actions, policies and accountabilities, and will have regard to how these will be funded.

Contents

Foreword	1
Let us know what you think	2
Executive Summary	6
Introduction	11
Chapter 1: Flooding in Victoria	11
Chapter 2: The strategic approach	11
Chapter 3: Purpose of the strategy	12
Chapter 4: A short history of floodplain management	14
Chapter 5: Aligning with the Victorian and national approaches to disaster resilience	14
Chapter 6: Aligning with the national flood warning arrangements	16
Section 1: Assessing Flood Risks and Sharing Information	18
Chapter 7: Flood risk metrics	19
7.1 Annual exceedance probability (AEP)	19
7.2 Population at risk	19
7.3 Average annual damage	19
Chapter 8: Sharing flood risk information	19
8.1 Flood risk maps	20
8.2 Victorian flood databases	20
8.3 Victoria's flood intelligence platform	20
Chapter 9: Regional floodplain management strategies	21
9.1 Involving all stakeholders	22
9.2 Flood risk assessments	22
9.2.1 Regional risk assessments	22
9.2.2 State-wide risk assessment	22
9.3 Detailed flood risk evaluations (flood studies)	23
9.4 Incorporating changing rainfall patterns in risk assessments	24
9.5 Taking account of Aboriginal cultural heritage in risk assessments	24
9.6 Taking account of environmental watering	24
9.7 Evaluating mitigation options	25
Section 2: Avoiding or Minimising Future Risks	26
Chapter 10: Mitigating flood risks through planning and building	27
10.1 The threshold flood risk in the built environment: the design flood event	27
10.2 Using planning systems to mitigate flood risk	27
10.2.1 Victoria's land use planning system	27
10.2.2 State and regional planning	28
10.2.3 Local area planning	28
10.2.4 Planning for access and egress	28

10.2.5 Existing planning coverage	29
10.2.6 Streamlining land use planning	30
10.3 The building system	30
Chapter 11: Planning around coastal inundation	31
11.1 The Interaction between coastal processes and coastal flooding	31
11.2 Identifying risks at the regional level	31
11.3 Supporting adaptation responses	32
11.4 Planning for rising sea levels	32
Section 3: Reducing Existing Risks	35
Chapter 12: Flood warnings	35
12.1 The Total Flood Warning System concept	35
12.2 Assessing TFWS service at the state, regional and local level	35
12.3 Matching TFWS services with community needs	36
12.4 Operating and maintaining a TFWS service	38
12.5 Review	39
Chapter 13: Flood mitigation infrastructure	39
13.1 Establishing new flood mitigation infrastructure	41
13.1.1 Establishing Water Management Schemes	41
13.1.2 Management framework for flood mitigation infrastructure	42
13.1.3 Cost-sharing arrangements	42
13.1.4 Planning controls behind formally managed levees	42
13.1.5 Management arrangements for levees in rural areas	43
13.1.6 Essential service providers	43
13.2 Bringing existing infrastructure into formal management arrangements	44
13.2.1 Context	44
13.2.2 Formalising the management of existing infrastructure	44
13.2.3 Cost-sharing arrangements	45
13.2.4 Opting to leave existing infrastructure unmanaged and unmaintained	45
13.2.5 Decommissioning flood mitigation infrastructure	45
13.3 Maintaining levees that are not formally managed	45
13.3.1 A permit system for levee maintenance on Crown land	46
13.3.2 Respecting Aboriginal and cultural heritage	46
13.3.3 Respecting environmental values	46
13.4 Cross-border issues	47
Chapter 14: Flood mitigation activities on waterways	48
14.1 An authorisation framework for flood mitigation activities on waterways	48
14.1.1 Authorisation for larger-scale activities for urban areas	48
14.2 Authorisation for small-scale activities	49
14.3 Linkage with the rural drainage strategy	49
Chapter 15: Reforming stormwater management in Melbourne and regional cities and towns	50
15.1 Urban stormwater flooding	50
15.2 Urban water reform agenda	51
Chapter 16: Business continuity plans for critical infrastructure	57

Section 4: Managing Residual Risks	56
Chapter 17: Flood insurance	58
Chapter 18: Disclosing flood risk information	59
18.1 Comprehensive flood mapping	59
18.2 Vendor disclosure statements	59
Chapter 19: Integrated flood emergency management	60
Chapter 20: Incident control	61
Chapter 21: Managing residual water	62
Acronyms	63
Glossary	64

Executive Summary

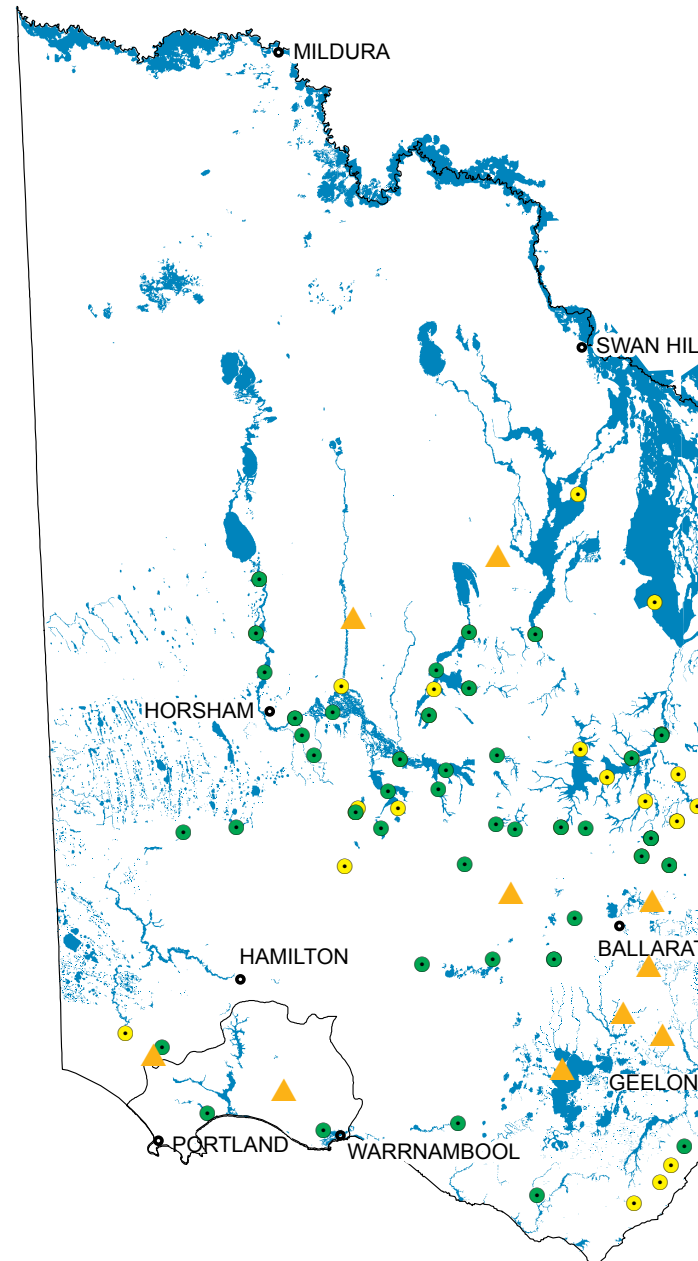
This Draft Victorian Floodplain Management Strategy provides an opportunity for community input to the actions, policies and accountabilities that will set the direction for floodplain management in Victoria over the next decade. It replaces the 1998 Victoria Flood Strategy.

It aligns with the Victorian Government's responses to the Victorian Floods Review and the parliamentary inquiry into flood mitigation infrastructure. It also aligns with the broader emergency management framework set out in the Emergency Management Act 2013. Importantly, by considering whole-of-water-cycle-management (WWCM) it also helps to integrate floodplain management with the government's urban water reform agenda, the Victorian Waterway Management Strategy and the Victorian Coastal Strategy.

There are four key parts to this strategy:

- **Assessing Flood Risks And Sharing Information** sets the framework for assessing and prioritising management linked to the level of flood risks;
- **Avoiding or Minimising Future Risks** sets the proposals and accountabilities to avoid making matters worse;
- **Reducing Existing Risks** clarifies the institutional arrangements for both structural and non-structural measures to mitigate the risk and consequence of floods. It also explains how flood warning systems will be tailored to meet community needs and how the long-term risks of nuisance flooding will be managed through reduced stormwater runoff.
- **Managing Residual Risks** focuses on how access to better information can reduce the consequence of flood events for individuals and emergency managers in responding to emergencies. The response and recovery activities align the strategy with the broader emergency management framework.

Figure 1: Draft Victorian Floodplain Management Strategy at a Glance



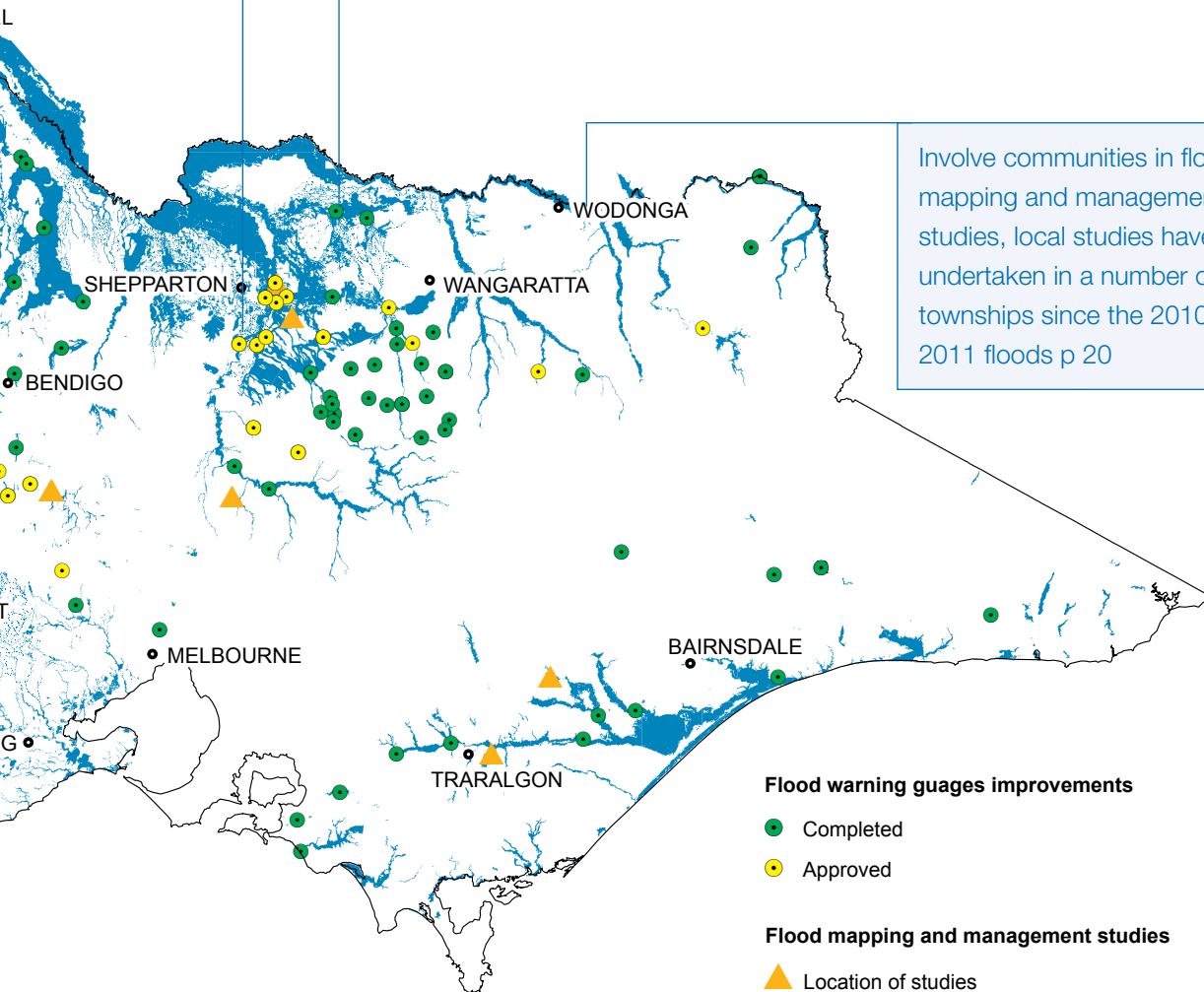
Increase access to information to encourage flood insurance to be taken up commensurate with an individual's risk p 58

Assist councils to implement water management schemes for flood mitigation infrastructure p 41

Improving flood warning systems
p 35-39

- 161 Flood warning gauge upgrades complete
- 40 flood warning gauge upgrades planned

Involve communities in flood mapping and management studies, local studies have been undertaken in a number of townships since the 2010 and 2011 floods p 20



Provide access to better quality mapping to support emergency services response and recovery p 20-21

Provide guidance for preparing regional floodplain management strategies based on a risk assessment framework p 21-25

Encourage increasing land-use planning coverage for areas in the 1% Annual Exceedance Probability (AEP) p 29-30

Chapter summaries

(1-6) Introduction

The introductory chapters set the context for the strategy. The focus is on communities and businesses becoming more involved in managing their own flood risks. It emphasises a shift away from relying on response and recovery efforts and towards mitigation. The strategic approach informs the strategy's vision, objectives and the outcomes that will be used to evaluate the effectiveness of the strategy's implementation.

A chapter on the history of floodplain management acknowledges the 1970's transition away from only structural mitigation efforts towards an approach that includes both structural and non-structural measures. It recognises that the technical foundations of the 1998 strategy are largely still relevant. The history chapter focuses the strategy on the opportunities to reinforce and modernise Victoria's floodplain management framework.

Assessing Flood Risks and Sharing Information

(7) Flood risk metrics

- Flood risk is a combination of the likelihood of a flood occurring and the consequences of the flood when it does occur. Flood risk is the result of the ways in which people choose to use those parts of the landscape that flood.
- Flood risk analysis involves an understanding of:
 - the probability of flood events
 - the population at risk
 - the average annual damages associated with different events.
- Future flood maps will consider a range of floods; these maps and flood studies will be updated periodically to take account of changes to flood risk.

(8) Sharing flood risk information

- The draft strategy identifies opportunities to share flood risk information with communities, businesses and emergency response agencies so that they can each better manage their risks.
- To achieve this, the strategy proposes community involvement in the flood studies that develop flood maps (making use of local knowledge) and the opportunity to provide input to an authoritative record of flood data in Victoria before, during and after floods. Specifically the Department of Environment and Primary Industries (DEPI) will:

- set flood mapping standards to meet the purposes of a range of users
- maintain and continually improve Victoria's flood intelligence platform.

(9) Regional floodplain management strategies

- Regional floodplain management strategies will provide the basis for assessing flood risk priorities across Victoria. DEPI is developing a consistent risk assessment framework for Catchment Management Authorities (CMAs) and Melbourne Water (MW) to use in preparing regional strategies. This will include an assessment of:
 - whether individual Total Flood Warning Systems (TFWS) are appropriately tailored to flood risks
 - areas where flood risk is not considered in land use planning
 - the potential needs for flood mitigation infrastructure
 - areas that may require detailed flood risk evaluations.
- Regional strategies will be developed in consultation with key stakeholders.

Avoiding or Minimising Future Risks

(10) Mitigating flood risks through planning and building

- Community resilience can be improved by using a mix of strategic and statutory planning tools.
- Land use planning and building controls are generally more cost effective than flood mitigation infrastructure, flood warning systems, flood education programs or flood emergency responses.
- The draft strategy sets out the direction for considering access and egress matters in land use planning. The State Emergency Service (SES), MW and CMAs will advise local councils on an area's suitability for development when they are preparing regional growth plans.
- The 1% Annual Exceedance Probability (AEP) flood will remain the design flood event to regulate new development and construction standards in Victoria.
- Local councils have an important role in ensuring that their planning schemes correctly identify the areas at risk of a 1% AEP flood.
- DEPI will work with local government to streamline the processes involved in converting flood study outputs into appropriate Municipal Planning Scheme amendments.

(11) Planning around coastal inundation

- The primary causes of coastal inundation are storm surges combining with high tides (storm tides) and extreme wave events. Flooding can be worsened in estuaries by rainfall in coastal catchments.
- This strategy aligns with the Victorian Coastal Strategy and supports the development of Regional Coastal Plans to inform coastal adaptation plans, which will, among other things, identify areas of coastal land at risk from erosion and inundation, consider adaptation responses and identify priority areas for risk management.
- Local councils will make locally based decisions about managing the risk of coastal flooding – informed by relevant government policies and advice from local communities and experts on coastal flooding and coastal erosion.

Reducing Existing Risks

(12) Flood warnings

- Effective flood warnings can help mitigate flood damage by providing communities and emergency response agencies with information about when a flood may occur and the likely severity of that flood.
- All Victorian communities receive a flood warning service. The nature of the service for a given community will be based on flood risks. Communities with high potential for flood damage already receive a more sophisticated level of service.
- This strategy sets the framework to assess, establish, revise, operate, maintain and review TFWSs relevant to flood risks and community need across Victoria.
- TFWSs draw on a number of agencies for effective implementation. The draft strategy identifies the roles of the various agencies involved in operating and maintaining a TFWS.

(13) Flood mitigation infrastructure

- This chapter considers the management arrangements of flood mitigation infrastructure in Victoria. It aligns with the government's preference to implement flood mitigation infrastructure through Water Management Schemes, and is explicit about the role of local council in managing flood mitigation infrastructure.
- The arrangements in place for Kerang and Nathalia should be seen as best practice and local communities should be involved in decision making about whether flood mitigation infrastructure is required.
- DEPI will provide assistance to councils and other authorities to help them develop and implement formal Water Management Schemes for the management of flood mitigation infrastructure.

- Local councils may opt not to formally manage existing infrastructure, but if so, their planning schemes must acknowledge that the infrastructure will not provide any flood protection and they must plan for an emergency associated with its catastrophic failure.
- The draft strategy proposes to streamline environmental approvals process to maintain levees on Crown Land.
- It also identifies Victoria's approach to cross-border collaboration to manage flood risks and coordinate emergency responses.

(14) Flood mitigation activities on waterways

- The Victorian Waterway Management Strategy (VWMS) 2013 provides the framework for maintaining and improving the condition of Victoria's rivers, estuaries and wetlands. It aims to ensure that waterways continue to support environmental, social, cultural and economic values for all Victorians.
- Flood mitigation activities on waterways (such as vegetation clearance, debris removal and sediment removal) must be carried out in ways that are consistent with the VWMS.

(15) Reforming stormwater management in Melbourne and regional strategies

- The government's urban water reform agenda offers a holistic approach to whole-of-water-cycle management (WWCM). It focuses on understanding the system through improved data and knowledge, through innovation, through economic reform, through improved governance and an improved legislative environment, and through improved planning and project facilitation.
- Using a WWCM approach will enable different considerations to be applied at household, precinct, suburb, local, regional and metropolitan scales, better reflecting local conditions and needs.
- The new WWCM approach will progressively be extended from Melbourne to regional cities and towns, where local community engagement will help decide how the strategy can be used most effectively in each location to suit local circumstances.

(16) Business continuity plans for essential services

- The operators of essential-services infrastructure are now responsible for developing and implementing site-specific strategies to mitigate all risks to business continuity.
- The operators of essential-service infrastructure are each accountable for:
 - assessing the risks posed to their operations by flooding
 - developing and implementing fit-for-purpose flood risk mitigation plans for each facility at risk of flooding
 - developing fit-for-purpose flood response plans.

Managing Residual Risks

(17) Flood insurance

- Governments have a role in ensuring that:
 - individuals and communities affected by floods are able to recover and rebuild as quickly as possible
 - people are able to choose where they live in an informed way (the relative size of flood insurance premiums in different locations provide an important signal in this regard)
 - individuals and communities at risk of future flooding are aware of the risks and are able to obtain suitable protection against those risks – both in terms of having access to insurance and in benefiting from appropriate mitigation strategies.
- DEPI will work with the insurance industry to facilitate exchange of mapping and other flood risk information in order to ensure fair pricing of insurance.

(18) Disclosing flood risk information

- When they do occur, floods with probability lower than the 1% AEP flood event will cause significant damage and considerable cost. While the costs of mandating higher floor levels for new buildings would be hard to justify outside the 1% AEP flood, it is still important for people living and working in those flood-prone areas to be able make informed decisions about risk management.
- To encourage property owners to take an active interest in ensuring that their insurance premiums are tailored to their flood risks, DEPI will seek to ensure full disclosure of the probability of individual properties on floodplains being flooded in any given year.
- Emergency services need to be able to plan with their communities for flooding beyond the 1% AEP event. They also need to be in the position to issue accurate and timely warnings for these floods.

(19) Integrated flood emergency management

- In Victoria, emergency management has been structured around three separate but interdependent components:
 - Prevention: reducing or eliminating the incidence or severity of emergencies and mitigating their effects
 - Response: combating emergencies and providing rescue and immediate relief services
 - Recovery: assisting of people and communities affected by emergencies to achieve a proper and effective level of functioning.

- State-wide accountability for these three components needs to be assigned and tailored for particular hazards and organisations. When it comes to floods, DEPI, MW and the CMAs have primary responsibility to work with local councils and SES on prevention activities. SES has primary responsibility for response activities. The Department of Human Services (DHS) has primary responsibility for coordinating recovery activities.

(20) Incident control

- The SES has a lead role in flood response, with advice provided from DEPI, CMAs, MW and the Bureau of Meteorology.
- SES, with support from DEPI, is accountable for setting the requirements for flood interpretative services to support incident controllers during floods. SES is accountable for ensuring arrangements are in place to access flood specialist expertise during floods.
- Emergency management agencies will need to work with Aboriginal people to help ensure Victoria's emergency management arrangements take into account the risks to Aboriginal cultural heritage.

(21) Managing residual water

- DEPI is accountable for maintaining guidelines for managing water that remains in the landscape after flood peaks have passed.
- The risks to health, community well-being and regional economies mean that key decisions may need to be made about if and when to remove residual water and when to stop. Interventions should stop once the risks have been reduced to tolerable levels.

Introduction

Chapter 1: Flooding in Victoria

Flooding is a natural hazard in Victoria's river systems and in natural and constructed drainage systems. Whether floods are caused by high rainfall, storm surges or inadequate drainage, they can severely disrupt communities by causing loss of life, property damage, personal hardship, crop damage and stock losses.

It is a question of *when*, not *if*, floods will occur. Fortunately, the location, the scale of effects and the probability of occurrence can be determined, with reasonable accuracy, for a range of floods.

Understanding flood behaviour enables us to assess the likely costs of flooding. It also enables us to assess the benefits of different options for managing the community's exposure to flood risk.

Floods risks are created by people's interactions with floodplains. Those interactions expose people, animals and the built environment to flood hazards. The higher the probability of floods occurring, and the greater the consequences of those floods, the greater the flood risk.

Because the probability of floods of different heights and extents can be estimated, it can also be considered in decision-making. Floods are potentially the most manageable disasters confronting Victoria.

This floodplain management strategy sets out a systematic approach to evaluating Victoria's flood risks. It also provides a systematic approach to sharing flood risk information with the individuals, communities, government agencies and other organisations responsible for managing the various aspects of flood risk.

Chapter 2: The strategic approach

The lessons from the 2010, 2011 and 2012 flood emergencies highlight the need for a modern framework to manage floods, protect communities and save lives.

It is critical that steps are implemented in the immediate future to ensure exposure to flooding does not increase significantly. The need for this was demonstrated by the 2011 flood in Brisbane, which, in many places, was smaller than the 1974 flood yet the damage was nearly 10-fold greater. This is a simple but stark example of what can happen when development occurs without due consideration of flood risk.

Enhanced effort in municipal planning, supported by increased knowledge of flood hazards, will go a long way towards securing our resilience to floods. Flood overlays need to be updated as soon as possible after new flood maps are produced. Our investment in flood information must pay dividends. Government has a role to play, but communities and businesses must also act to manage their own risks. Beyond planning controls, communities and businesses must use knowledge about flood hazards to guide the placement and ongoing protection of essential-service infrastructure such as roads, power sub-stations, gas lines and telecommunications infrastructure.

There are no quick fixes in reducing the damage caused by widespread flooding. Two centuries of development on floodplains and low-lying areas mean that legacy issues will remain for a very long time.

The constant refrain in emergency management reforms is that the job is a shared responsibility. In practice, the focus needs to be on specific accountability. Flood emergency management relies on absolute clarity about who is accountable for what.

Clear accountabilities must not be blurred by shared responsibilities. The same applies to floodplain management. 'Responsibility' is about ownership of an endeavour. 'Accountability' is about being answerable for the outcome of those efforts. Responsibility can be shared; accountability cannot. This strategy focuses on identifying accountabilities.

The State Government is actively reforming and integrating emergency management across multiple hazards (e.g. fire and flood). However, experience has shown that response and recovery assistance cannot offset the damage caused by such emergencies. The government is therefore driving a focus on mitigation to reduce the need for response and recovery. This strategy reflects that drive.

Attempts over the past century to use engineering solutions to mitigate flooding have had mixed results. The risks associated with unmaintained, low-construction-standard levee systems are high. Spending funds on levees, and other flood mitigation infrastructure, without understanding their full costs and benefits, doesn't make sense. It is time to rethink and reset our approach.

We need to focus on providing certainty around the ongoing management and maintenance of flood mitigation infrastructure. We need regular auditing of the infrastructure and its maintenance. Quite apart from the risks of levee failure, there remains a real likelihood that levees may overtop. These risks must be documented, communicated and incorporated into municipal emergency planning.

Flooding within urbanised environments is a further legacy issue. Many houses were built on old creek lines and impervious urban surfaces increase rainfall runoff, causing damage and disruption. Opportunities to reduce flooding through improved integration of water and urban planning need to be explored.

The role of insurance in reducing exposure to flooding for communities and businesses, and also government, cannot be over-estimated. However, insurance policies must be affordable and be priced to reflect the true nature of the risk. Knowledge of the flood hazard is fundamental. Insurance provides the opportunity to reduce exposure from legacy decisions but also will guide future development on floodplains as premiums are influenced by the flood risk.

Technology enables forewarning of potential floods to a much greater extent than ever before. Weather forecasting services are widely available and are broadcast on mainstream media. Individual stream gauge information is available online. Coupled with online weather radar services, this information helps people make judgements about looming floods. If the community flood risk is great enough, these basic services can be supported by more comprehensive flood warning systems.

Even in those areas of high risk where there are more sophisticated formal flood warning systems, there will still be a need for localised flood warnings (driven by local knowledge and community networks). Communities along over 100,000 kms of Victoria's rivers and creeks, need different levels of warning service to reflect their different risks. Planned levels of warning service must therefore be documented, maintained and communicated to communities to ensure they have the capacity to use the information provided during a flood.

Local knowledge is invaluable in helping to better understand flood behaviour and the options for flood mitigation infrastructure, and the willingness and capacity to pay for ongoing mitigation costs. Local knowledge helps identify gaps in warning systems and guide land use planning. It is government's role to provide opportunities to capture the wealth of local knowledge; there will be requirements for community involvement in local flood studies.

Individuals and organisations are being actively encouraged to comment on this draft strategy so that their knowledge and experience will strengthen the final strategy. This practice will continue with the development of regional floodplain management strategies; it will help identify gaps and set regional priorities.

Our understanding of potential changes in flooding in a changing climate is evolving. Decision-making must be responsive to the latest scientific information.

Chapter 3: Purpose of the strategy

This strategy builds on the lessons learnt from the 2010 to 2012 floods. It aims to use those lessons to shape the future of effective floodplain management in Victoria. By providing a consistent statewide framework for the management of flood related issues, it aims to inform a consistent stream of decisions and actions over the next ten years.

The vision of the strategy and its objectives are described in Figure 2 (opposite) along with the practical outcomes that we expect will come out. We will evaluate the effectiveness of this strategy by how well it delivers those outcomes.

Figure 2: Vision, objectives and outcomes of the strategy



Chapter 4: A short history of floodplain management

Waterways and floodplain areas have always been important places for Aboriginal people to come together as families and communities for cultural, social and recreational activities. Access to floodplain areas is vitally important for these activities to continue and for future generations of Aboriginal people to learn about their culture.

Victoria's early European settlers also valued access to rivers and streams for benefits of water supply, transport, fertile soils and waste disposal. Many settlements along rivers and streams grew into substantial but flood-prone communities.

The settlers became increasingly aware of their flood risks in the late 1800's. Their initial response was to build levees that, at the time, were not subject to planning controls or engineering construction standards. Typically, these early levees were built to poor standards with unsuitable soils. Significant failures were common during floods. Moreover, the nature of flooding was not well understood and levees were often constructed too close to waterways. They constricted the floodplains, causing high-energy, erosive flows rather than taking advantage of the floodplain's natural capacity to slow down, convey and store floodwater.

Until the record floods of 1974, floodplain management in rural Victoria was largely a local government responsibility; state government agencies had very little involvement. The institutional arrangements were changed dramatically in 1975 when government agencies were given statutory functions to carry out flood studies, implement flood strategies and provide flood advice to councils in rural Victoria. This approach was codified in the 1978 handbook, *Flood Plain Management in Victoria*.

Even without today's sophisticated computer models, the flood studies of that time helped transform people's understanding of floods. Rather than keeping on trying to get rid of floodwaters as quickly as possible, engineers started to mimic nature by slowing the flood water. They did this by building retarding basins and by recognising the benefits of maintaining access to the natural flood-storage capacity of floodplains. At the same time, local councils started to introduce planning controls to avoid or minimise the growth in future flood risks.

Gradually, Victorians recognised the need for an overall floodplain management strategy embracing a mix of structural and non-structural measures to deal with flood risks.

In 1998, the landmark Victorian Flood Management Strategy codified the accumulated wisdom of best practices in floodplain management to that date. The 1998 strategy remains directly relevant to the contemporary challenges of floodplain management in Victoria. Its technical basis is still sound. This enduring technical foundation means that the challenges for the 2014 Victorian Floodplain Management Strategy are not technical, they are institutional.

For example, there is an opportunity to strengthen the role of one of the 1998 strategy's programs, land use planning. The success of land use planning depends on the capacity of local councils. Melbourne Water's (MW) collaborations with local councils in Melbourne provide an example of how it is possible for land use planning to be applied throughout a region. There are still significant opportunities on large parts of Victoria's rural floodplains to increase the coverage of appropriate planning controls. This strategy must ensure that those remaining areas are covered.

Two other 1998 strategy programs – flood warning systems and flood mitigation infrastructure – are driving reforms in Victorian floodplain management, triggered by the devastating consequences of the 2010-11 floods. The Victorian Floods Review (VFR) and the Parliamentary, Environment and Natural Resources Committee (ENRC) Inquiry into Flood Management Infrastructure enabled the Victorian Government to set processes in train that will ensure Victoria is better protected for the future.

This strategy provides the implementation pathway for the Victorian Government's response to those inquiries. It also develops institutional arrangements to ensure continual improvement in all aspects of floodplain management.

Chapter 5: Aligning with the Victorian and national approaches to disaster resilience

This strategy marks a new era in floodplain management. It has been developed in consultation with all the agencies involved in floodplain management. It focuses on flood prevention and mitigation activities aligned with water portfolio functions under the *Water Act 1989*. More than that, it specifies how those activities will dovetail with activities under other portfolios (see Figure 3).

Figure 3: Links to activities undertaken by other portfolios

Minister for Environment and Climate Change Portfolio		Minister for Water Portfolio		Minister for Planning	Minister for Police	Minister for Health
<p>Victorian Coastal Council</p> <p>Coastal Strategy</p>	<p>VEWH</p> <p>Seasonal Watering Plans</p>	<p>DEPI</p> <p>Victorian Waterway Management Strategy</p>	<p>DEPI</p> <p>Floodplain Management Strategy</p> <p>Aligns with broader emergency management framework</p> <p>Sets floodplain management policy direction and accountabilities</p>	<p>DTPLI</p> <p>Policy and VPP (SPPF)</p> <p>Sets the framework and strategic direction for LUP in Vic</p>	<p>VicSES</p> <p>State Flood Emergency Plan</p> <p>Sets framework and response arrangements for floods</p>	<p>DHS</p> <p>Flood Recovery Plan</p> <p>Sets the framework for flood recovery</p>
<p>Victorian Coastal Council</p> <p>Coastal Strategy</p>	<p>VEWH</p> <p>Seasonal Watering Plans</p>	<p>DEPI</p> <p>Victorian Waterway Management Strategy</p>	<p>DEPI</p> <p>Floodplain Management Strategy</p> <p>Aligns with broader emergency management framework</p> <p>Sets floodplain management policy direction and accountabilities</p>	<p>OLV</p> <p>Living Victoria Policy and Melbourne's Water Future</p> <p>Sets the framework for Whole-of Water-Cycle Management (WWCM) to provide long-term reductions in flood risks through improved storm water management</p>	<p>DTPLI</p> <p>Policy and VPP (SPPF)</p> <p>Sets the framework and strategic direction for LUP in Vic</p>	<p>VicSES</p> <p>State Flood Emergency Plan</p> <p>Sets framework and response arrangements for floods</p>
<p>Regional coastal plans</p> <p>Identify areas subject to coastal risk and set regional priorities</p>	<p>CMA's</p> <p>Identify water regime requirements</p> <p>VEWH actions</p>	<p>CMA's</p> <p>Regional Waterway Strategies</p> <p>Aboriginal engagement requirements</p> <p>Determine areas of priority in relation to waterway management</p>	<p>CMA's</p> <p>Regional Floodplain Management Strategies</p> <p>Set regional floodplain management priorities based on state-wide risk assessment framework</p>	<p>Sub-regional WWCM Plans</p>	<p>Regional Flood Emergency Plans</p> <p>Set preparedness and operational arrangements for floods</p>	<p>Collecting new flood recovery data</p> <p>Feedback to State and regional level floodplain management strategies</p>
<p>Local councils</p> <p>Prepare coastal adaptation plans and hazard assessment of local areas to identify need for works and measures to manage risk</p>	<p>Water corporations deliver environmental water</p>	<p>CMA's</p> <p>Issue permits for clearing waterways for floodplain management purposes and flood mitigation works</p>	<p>Local Councils</p> <p>Water Management Schemes</p> <p>Formal process to construct and manage flood mitigation infrastructure</p>	<p>Local Councils</p> <p>Local Planning Policy Framework (LPPF)</p> <p>Municipal Strategic Statements set local objectives and strategic directions</p> <p>Apply appropriate zones and overlays</p>	<p>Local Councils</p> <p>Municipal Emergency Management Plans</p> <p>Set the operational arrangements for floods in local areas</p> <p>Prepared with community input</p>	<p>Local councils</p> <p>Local Flood Recovery Plans</p>
<p>Indigenous</p>	<p>Broader Emergency Management Framework. Flood, fire, tsunami, terrorism, etc</p>	<p>CMA's and/or local councils</p> <p>Local flood studies</p> <p>Identify flood mitigation response</p> <p>CMA's issue permits for mitigation works</p>	<p>Local Councils</p> <p>Water Management Schemes</p> <p>Formal process to construct and manage flood mitigation infrastructure</p>	<p>Local Councils</p> <p>Local Planning Policy Framework (LPPF)</p> <p>Municipal Strategic Statements set local objectives and strategic directions</p> <p>Apply appropriate zones and overlays</p>	<p>Local Councils</p> <p>Municipal Emergency Management Plans</p> <p>Set the operational arrangements for floods in local areas</p> <p>Prepared with community input</p>	<p>Local councils</p> <p>Local Flood Recovery Plans</p>

STATE

REGIONAL

LOCAL

The 2009 National Strategy for Disaster Resilience describes a disaster-resilient community as one that works together to understand and manage the risks it confronts. It further states that disaster resilience is the collective responsibility of all sectors of society, including all levels of government, business, the non-government sector and individuals.

The National Strategy initiates a national review of land use planning and building codes to consider ways to enhance disaster resilience in the built environment.

This floodplain management strategy responds to the National Strategy by:

- developing systems and processes to improve the quality of flood maps
- developing maps that show a range of flood probabilities, to better regulate land use in areas liable to flooding
- considering appropriate changes to land use planning and building codes
- ensuring that local inputs are considered when developing solutions to local issues.

The 2012 Victorian Emergency Management Reform White Paper reinforces the ‘all-hazards all-agencies’ approach to emergency management. Strategic priorities include building community disaster resilience and streamlining governance arrangements.

The *Emergency Management Act 2013* implements many of the reforms from the White Paper, repealing most of the 1986 Act. The reforms in the 2013 Act include:

- formally establishing the State Crisis and Resilience Council (SCRC) as Victoria’s peak emergency management advisory body, and discontinuing the Victoria Emergency Management Council (VEMC)
- establishing Emergency Management Victoria (EMV) as the responsible agency for the coordination and development of whole-of-government policy for emergency management in Victoria
- establishing the Emergency Management Commissioner (EMC) as the successor to the Fire Services Commissioner with an over-arching management role for major emergencies
- establishing the Inspector General for Emergency Management (IGEM) to provide assurance to the Government and the community regarding Victoria’s emergency management arrangements, discontinuing the Emergency Services Commissioner.

Figure 52, from the recently released Australian Emergency Management Handbook 7: *Managing the floodplain: a guide to best practice in flood risk management in Australia* (figure 4 below), illustrates the various steps involved in moving along the continuum from a flood study to on-ground action. Victoria follows this approach.

Figure 4: The flood risk management framework (from Australian Emergency Management Handbook 7)



Chapter 6: Aligning with the national flood warning arrangements

The *National Arrangements for Flood Forecasting and Warning* are being developed as part of the Standardisation of Bureau of Meteorology (BoM) Services task force that reports to the Australia and New Zealand Emergency Management Committee (ANZEMC).

The document provides the Australian community and key stakeholders with a summary of how flood forecasting and warning services operate across Australia. The arrangements describe a collaborative approach involving all levels of government. The National Arrangements outline the roles and responsibilities of each level of government in providing and supporting an effective flood warning service, along with the legislative and administrative arrangements that influence the activities of the various agencies involved.

It includes a separate chapter for each State and the Northern Territory describing the specific arrangements and agency roles that apply in each jurisdiction.

The Flood Warning Consultative Committee (FWCC) is an advisory body, reporting to BoM and participating state and local government agencies as required. The Victorian FWCC was formed in late 1989 and is chaired by BoM's Regional Director for Victoria; membership includes representation from Victorian State and local government agencies. The committee's overall role is to coordinate the development and operations of the State's flood forecasting and warning services. Its terms of reference are to:

- identify requirements for new and upgraded flood forecasting and warning systems
- establish the priorities for the requirements that have been identified using risk based analyses of the Total Flood Warning System
- annually review and provide feedback on the Service Level Specification for the BoM's Flood Forecasting and Warning Services
- 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.



Lock 10 on the Murray at Wentworth Source: Mallee Catchment Management Authority

Section 1

Assessing Flood Risks and Sharing Information



Flooding in Culgoa. Source: Mallee Catchment Management Authority

Chapter 7: Flood risk metrics

Flood risk is a combination of the likelihood of a flood occurring and the consequences when it does occur. Flood risks are the result of the ways in which people choose to use those parts of the landscape that flood.

Flood risks vary with the frequency of exposure to flood hazards, the severity of the hazard, the vulnerability of the community, the vulnerability of the built environment and the vulnerability of farming systems. An understanding of these interactions can inform decisions about how to manage flood risks.

Flood risks must be quantified if we are to rank their relative seriousness. This involves being able to measure in some way:

- the probability of flood events
- the population at risk
- the economic damage associated with different events.

7.1 Annual exceedance probability (AEP)

Floods of different sizes cause different amounts of damage and the size of a flood is linked to the probability of its occurrence. Since it is a question of when, not if, floods will occur, a community's exposure to flood risk centres on the probability of floods occurring. That probability can be expressed in several ways. Floodplain managers tend now to refer to the percentage annual exceedance probability (AEP) the probability each year of a certain size flood being equalled or exceeded.

The term AEP reinforces the fact that there is an ongoing flood risk every year – regardless of how recently there was a similar flood. In contrast, the term average recurrence interval (ARI), where probability is expressed as a return period in years, is now actively discouraged. Technically, these terms are interchangeable, but psychologically ARI can be misleading. People can be tempted to think that if they experience a '1-in-100-year' flood their property will then be safe for another 100 years. In reality, there is a 1% chance that they will experience a flood of the same size the next year.

Flood studies (section 9.3) provide a sound technical basis for developing calibrated and verified computer models that consider historic floods. These models help us to understand the probability of floods of different sizes occurring and the impacts of floods of different probabilities. Models can also provide an understanding of the probability that floods of a similar size to key historic events will recur.

The probability of a flood of a given size occurring remains the same from year to year – unless the flood regime is altered (for example by the presence of a new dam

or levee system) or new data leads to a revision of the statistical estimates. In practice, because both these things do continue to change, flood studies must be renewed periodically and flood maps updated.

Priorities for new and revised flood mapping will be identified through the Regional Strategies (section 9).

Proposed Policy 7a

- All future flood maps will provide an understanding of the impact of a range of floods, including relatively small and frequent events up to very large and rare floods, as well as major, moderate and minor flood levels where defined.
- Flood maps will be linked to a flood warning gauge, where one exists.

7.2 Population at risk

Floods put people who live, work or travel on the floodplain at risk of death, injury, disease, financial loss and social disruption. The nature of these risks can change with demographic trends and with the effectiveness of flood warnings and emergency responses.

There are different ways to measure the population at risk, depending on the detail required. In general terms, the larger the population at risk, the larger the number of people who need to be warned and, if necessary, evacuated.

The population at risk is not just about total numbers; it is also about vulnerability. Strategic land use planning and emergency management planning need to consider vulnerable sectors of the community at the local level. People in hospitals, nursing homes, schools, childcare facilities and corrective facilities are particularly vulnerable to flood, as are older people and people with limited mobility.

7.3 Average annual damage

Floods are generally regarded as causing three types of damage:

- **Direct tangible damages** include damage to the structure and contents of buildings, agricultural enterprises and regional infrastructure.
- **Indirect tangible damages** arise from disruptions to economic and social activities. They include the costs of emergency response, clean-up, community support, as well as disruptions to transport, commerce and employment.
- **Intangible damages** cannot be quantified in monetary terms, despite their significance. They include trauma, stress and the loss of biodiversity.

Floods of different sizes cause different amounts of damage. For a given flood-prone area, the damage caused by floods of various magnitudes can be averaged to determine the average annual damage (AAD).

AAD provides a basis for comparing the economic effectiveness of different structural and non-structural mitigation measures. It allows the costs of mitigation to be compared with the benefits of mitigation (in terms of reduced AAD).

Chapter 8: Sharing Flood Risk Information

This section of the strategy outlines the ways in which information about flood risks is shared with individuals, government agencies and other organisations so that each can play their part in flood emergency management.

8.1 Flood risk maps

Flood risk maps are an output of flood studies (section 9.3). DEPI is responsible for developing consistent standards for mapping flood risks. Those standards now extend to flood mapping for a range of floods, not just the information required for planning and building controls. The standards will include requirements for local consultation during the preparation of flood maps and the incorporation of local knowledge.

Accountability 8a:

- DEPI is accountable for setting flood mapping standards to meet the needs of a range of uses, including land use planning, insurance and emergency response.
- DEPI and Melbourne Water are accountable for providing a repository for the storage and custodianship of flood maps developed as part of government-funded flood studies.

In support of this commitment, DEPI will ensure that all new government-funded flood maps for urban and regional areas will:

- be developed in consultation with local communities to make use of local knowledge
- be informed by the most recent edition of Australian Rainfall and Runoff (ARR) – A Guide to Flood Estimation
- be of sufficient quality for inclusion in Municipal Planning Schemes
- include information for a range of floods, from 20% to 0.1% AEP – and rarer floods where appropriate

- take account, where relevant, of the *State Planning Policy Framework (SPPF)* strategies “to plan for and manage the potential coastal impacts of climate change” (section 11.4)
- be quality assured
- be stored in Victoria’s flood databases.

8.2 Victorian flood databases

The Victoria Flood Database (VFD) and Melbourne Water’s Flood Database (MWFD) together provide for the systematic collection, collation, analysis and presentation of Victoria’s quality-assured flood information. That information is available in geographic information system (GIS) formats.

The quality of existing data is variable; it ranges from basic, historic and interpreted data through to the outputs of recent flood studies. Older flood study data and flood maps are updated as newer information becomes available. The databases are therefore in a state of continual improvement.

The consultants producing flood studies are required to deliver data to the VFD as GIS layers in particular coverage formats. The VFD currently consists of 26 data layers. One of these of particular importance for land use planning shows the 1% AEP flood level. There are up to nine other flood levels in a range from moderate to extreme. These other levels are critical for emergency management planning and response. They are also of potential importance in enabling insurance premiums to reflect risk accurately.

Accountability 8b:

- DEPI and Melbourne Water are accountable for maintaining and continually improving guidelines for the management of Victoria’s flood databases.
- DEPI is accountable for maintaining and continually improving protocols for updating the data in the Victoria flood database.

Proposed Action 8a:

- DEPI and Melbourne Water will integrate the two existing databases to provide Victorians with a single point of entry to readily accessible authoritative records of flood data in Victoria.

8.3 Victoria’s flood intelligence platform

DEPI is developing a web-based flood intelligence platform to be the authoritative source of flood intelligence before, during and after floods. It will be used by SES to bring together the outputs of weather forecast models, hydrologic models, hydraulic models, satellite observations and stream gauge data.

Most importantly, the flood intelligence platform will bring together flood-consequence information at the property scale, where possible. As with other web-based mapping services, it will help agencies with flood emergency management functions to quickly and accurately visualise the task in front of them in terms of both time and space.

The platform will help improve flood warning, preparedness and response activities for at-risk towns. It will also enable emergency services to share information during floods. In that way, it will support them in their endeavours to make real-time interpretations of likely flood behaviour, to coordinate flood responses and to assess flood impacts. It will help them provide better messaging to flood-affected communities.

The flood intelligence platform will underpin, streamline and improve the efficiency of the flood interpretative services provided by DEPI, Melbourne Water and the CMAs to SES and local councils. These agencies will use the information coming out of the flood intelligence platform to provide advice to flood-affected communities.

Accountability 8c:

- DEPI is accountable for maintaining and continually improving the flood intelligence platform into the future.

Proposed Action 8b:

- DEPI, in consultation with SES, Melbourne Water, the CMAs and local councils, will ensure the information in the flood intelligence platform remains current.

All agencies carrying out self-generated flood mapping exercises will be encouraged to follow existing DEPI guidelines. On completion of such maps, councils will advise DEPI and provide a copy of the mapping for inclusion in the VFD. Once DEPI is assured that the quality of the data represents an improvement over anything already in the VFD, it will make that information available to support emergency preparation and response.

Chapter 9: Regional floodplain management strategies

Regional floodplain management strategies give priority, at the regional and local levels, to the policies, actions and accountabilities outlined in this strategy. They align the efforts of various agencies and communities to deliver the outcomes called for by this strategy.

Regional strategies start with an assessment of flood risks across the region. Those risks are then assessed against the regional community's tolerance for flood risks. A range of mitigation measures are then explored for intolerable risks. At the regional level, mitigation measures might include strategic plans for land use and strategic plans for flood response arrangements.

At the local level, flood mitigation measures are usually investigated and assessed through detailed flood studies (section 9.3). Local mitigation measures might include improvements to total flood warning systems, changes to land use planning controls, changes to Municipal Emergency Flood Plans or improvements to flood mitigation infrastructure.

Regional strategies prioritise the actions necessary to put preferred mitigation measures in place. Priority is given to those actions that do most to narrow the difference between existing flood risks and the community's willingness to accept those risks.

Prioritisation is done in collaboration with all agencies with flood emergency management functions. The main role of regional strategies is to help these agencies to align their priorities with each other. Regional floodplain management strategies facilitate the practical linkages between floodplain management and all other aspects of flood management. The process of prioritisation enables those partner agencies to align their potential to source and allocate funds towards priority actions over a three-year rolling implementation plan.

The CMAs and Melbourne Water (MW) lead the development of regional floodplain management strategies in collaboration with their local communities, local councils, SES, water corporations and other partner agencies.

DEPI will prepare guidelines for the preparation of regional floodplain management strategies. These guidelines will outline consistent methods for assessing flood risks and assessing the community's tolerance for those risks. The methods will align with the principles of the National Emergency Risk Assessment Guidelines.

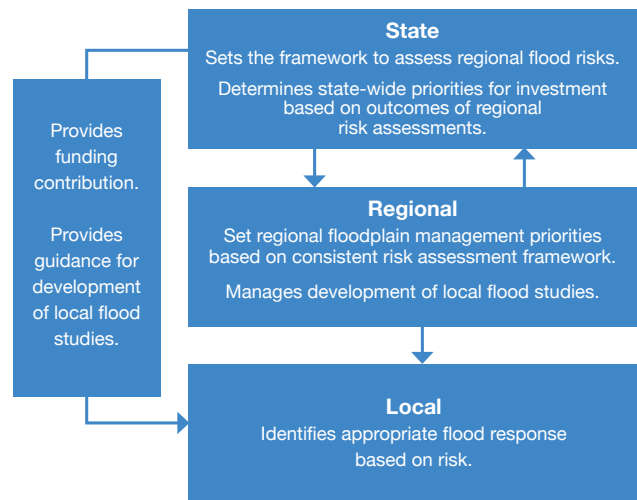
Accountability 9a:

- Melbourne Water and the CMAs are accountable for developing and periodically reviewing regional floodplain management strategies in partnership with their local communities.

Proposed Action 9a:

- DEPI will develop guidelines to enable the preparation of regional floodplain management strategies.
- The CMAs and Melbourne Water will each prepare regional floodplain management strategies for their regions.

Figure 5: Risk assessment framework, state, regional and local



9.1 Involving all stakeholders

The Victorian Emergency Management Reform White Paper makes it clear that: “effective emergency response relies strongly on pre-existing cooperative networks built and maintained during preceding years”.

Preparing a regional floodplain management strategy provides Melbourne Water and the CMAs with an opportunity to foster networks and a culture of shared responsibility. It provides an opportunity to establish and align regional priorities for SES, local councils, water corporations and community representatives. It also provides an opportunity to foster greater community involvement in the development and ownership of local plans. This is consistent with the National Strategy for Disaster Resilience.

9.2 Flood risk assessments

Addressing flood risks should be determined on a priority basis to deliver maximum benefit. Figure 5 shows the framework for assessing priorities that will be informed by the risk assessment applied at the regional scale.

9.2.1 Regional risk assessments

Regional priorities for government investment in floodplain management need to be informed by structured and standardised analyses and judgements regarding the relative priority of flood risks throughout the region. To that end, DEPI has commissioned work to adapt and refine its existing Rapid Appraisal Methodology for setting regional priorities.

The refined methodology will allow more rapid and more consistent evaluation of floodplain management measures in a benefit cost analysis framework. Consistency is required in order to ensure comparability between evaluations. Rapidity is required primarily because of the number of floodplain management programs requiring evaluation and because limited funds are available for the evaluation of those programs.

The aim is to allow for a consistent approach to assessing the flood risks for different towns so that we can be sure that towns with similar risks also have flood warning systems that offer similar levels of service.

Proposed Action 9b:

- DEPI will refine its rapid and robust methodology for establishing regional floodplain management priorities.

9.2.2 State-wide risk assessment

Once the regional floodplain management priorities are established, the next task is to set priorities at the state level. Again, there is a need for a structured and standardised methodology for making those judgements.

Because all future regional risk assessments will be based on a consistent methodology it will be possible to rank those risks consistently at the state level. This will, in turn, allow for mitigation priorities to be set at the state level.

Proposed Action 9c:

- DEPI will develop a rapid and robust methodology for establishing statewide floodplain management priorities.

9.3 Detailed flood risk evaluations (flood studies)

Floods are potentially one of the most manageable disasters confronting Victoria. We have tools to analyse their size, magnitude, frequency and impact on the landscape. We can also predict, with varying degrees of precision, how long we have before rain falling on a catchment aggregates into flooding on the floodplain.

Floodplains are important and valued places to work and live and, while we can protect some areas from flooding or raise floor levels, it is not economical, feasible or even desirable to completely eliminate flooding. Protecting part of the floodplain from flooding will often increase flood impacts elsewhere.

We can reduce flood damages and trauma if we have credible data about flood behaviour, such as flood heights, flood extents and flood probabilities. To collect that data we must continually improve our contemporary knowledge of flood behaviour.

Local risk evaluations, in the form of flood studies, can help fill gaps in knowledge and help in considering flood management options. Their usefulness depends on their technical rigour. They can be done to different levels of

complexity, depending on the outcomes required. High standards apply for complex flood situations with high – and potentially increasing – risk exposure. Less detailed investigations are used in areas where the population at risk is low and the AAD is low.

Flood studies must consider all sources of flooding in the area, as well as the interactions between them. They must seek to:

- model the hydrologic inputs – including rainfall and runoff – that lead to floods of different sizes and calibrate these models against historic floods
- model the hydraulic behaviour of floods – including flood heights, extents and velocities as they vary with time – and calibrate these models against historic floods
- understand the varying hydraulic nature of the floodplain being studied
- understand the varying flood hazard within the floodplain
- assess the scale of potential flood damages for the existing community
- assess the potential for flood damage on areas of the floodplain that may be considered for future development.

Flood study outputs must be capable of being used by a variety of stakeholders. They are useful only if individuals, communities, government agencies and other organisations have access to, can understand, and act on, high quality information about the risks of flooding. The outputs should be integrated into the relevant flood database, where they can be made readily accessible.

Case study: Natimuk Flood Investigation

On 12 January 2011 more than 100 mm of rain fell on the Natimuk Creek catchment. Within a day, Natimuk township was flooded. Residents tried to hold the floodwaters back with sandbags, but despite their best efforts water still flowed through many homes and businesses. The rapidly rising water took everyone by surprise. The people of Natimuk were frustrated by the lack of information about how bad the flood was going to get; it came as a shock when authorities began to advise them to leave their homes.

Wimmera CMA and Horsham Rural City Council moved to better prepare Natimuk’s 700 residents for future flooding. The Natimuk flood investigation was finished in early 2013. Between them, Horsham City Council, the Victorian Government (through the CMA) and the Australian Government shared the total cost of \$150,000. The people of Natimuk played an active part in the investigation. They provided local knowledge at community project meetings, shared ideas on the local facebook page and debated options at the town’s pub.

The Natimuk community now has access to detailed flood mapping and information about a range of floods. The SES community flood guide shows accurate local flood maps and other information drawn from the investigation. Horsham City Council is working with the state government to install a stream-flow gauge and a rain gauge on the creek upstream of town. The gauges will send real-time alerts about rising creek flows to a central location for dissemination to the community.

9.4 Incorporating changing rainfall patterns in risk assessments

Victoria's climate is extremely variable and our climatic records cover a relatively short time. Such changes need to be incorporated in risk assessments (section 9.3).

As discussed in section 7.1, the probability of a flood of a given size occurring or being exceeded remains the same from year to year – unless the flood regime is altered or new data leads to a revision of the statistical estimates. Every year we add new data to our climatic records. Over time, that accumulation of new data leads to a revision of the statistical estimates of flood probabilities. This includes the statistical estimates of the 1% AEP flood, which is important for land use planning (section 10.1).

Australian Rainfall and Runoff (ARR) – A Guide to Flood Estimation, the primary reference when it comes to designing and calibrating the hydrological and hydraulic models at the heart of flood studies, is being revised. Among other things, by mid-2015 it will include revised data and improved methods to estimate flows and flood levels from rainfall.

The revised ARR will also deal with the selection of climate change boundaries. It will provide guidance on appropriate climate scenarios to consider as part of the development of regional floodplain management strategies.

9.5 Taking account of Aboriginal cultural heritage in risk assessments

Floods and floodplain management activities can both present risks to Aboriginal cultural heritage. Regional flood assessments, local flood studies and flood mitigation works must take into account significant places, sites and landscapes.

Traditional Owners have a much broader information base about Aboriginal cultural heritage than is currently available to government. Therefore it is essential to consult with Traditional Owners in assessing and mapping flood risks.

Regional floodplain management strategies will therefore provide an opportunity to refine the relationships between natural resource managers and Aboriginal people; they will help to ensure cultural values are properly reflected in floodplain management. In working with Traditional Owners to achieve this outcome, the CMAs and Melbourne Water will follow the consultation and engagement processes outlined in the Victorian Waterway Management Strategy.

Processes are also needed to ensure that significant Aboriginal cultural values are considered as part of the Incident Control arrangements outlined in section 20. This would require governance arrangements that formally include the provision of advice on Aboriginal cultural heritage considerations.

9.6 Taking account of environmental watering

The link between floodplains and their rivers is important for overall health of river systems. Floods provide important physical connections between river channels and their natural floodplains; for example, they allow for the transfer of carbon and nutrients, which is important for the health of fish and other animal populations, and the prevention of water quality issues.

The construction of large dams (known as river regulation), together with water extraction for consumptive use, has significantly reduced flows within river channels and the frequency with which floodplains are connected to rivers through flooding. The duration and size of these floods has also been reduced.

Over the past decade or more, State and Commonwealth Governments have made significant investment to address the environmental impacts associated with river regulation and water extraction. Environmental water entitlements are now held by the Victorian Environmental Water Holder and the Commonwealth Environmental Water Holder, with the explicit objective of returning some flows back to river systems to achieve environmental outcomes.

Primarily, the focus of these environmental water holders is on providing flows solely within the river channel, well below levels that pose a risk to private land or infrastructure. However, in some instances, it is also possible to actively deliver environmental water to the floodplain. This occurs mainly on public land such as National Parks and State Forests, but may also occur on private land, where consent is provided by the landholder.

Environmental water holders work with the other environmental watering program partners, such as waterway managers and storage managers, to ensure that risks to third parties are appropriately managed in the delivery of environmental water. Where appropriate, this would include ceasing environmental water releases if significant rainfall and potential natural flooding were forecast.



Indigenous grinding grooves in Gippsland. Source: DEPI

9.7 Evaluating mitigation options

As outlined in Figure 4 (section 5), there are several steps in moving from a flood study to on-ground action. In practice, the challenge is to determine how much of this work can and should be done in parallel rather than in sequence. This varies with the degree of difficulty involved in securing:

- viable risk management options
- consistency with legislation and policy
- integration with statutory planning
- community support
- priority in capital funding programs
- ongoing funding for management and maintenance
- inter-agency commitment to seeing the action plan implemented.

As a general rule, the process should be condensed as much as practicable. It is important to capitalise on community receptiveness to flood mitigation options (including planning controls) – especially if the planning is being done soon after a flood. If the process drags out too long, the risk is that essential community support will diminish.

These processes are being accelerated significantly by ensuring that flood studies (section 9.3) provide more than maps of flood levels for different flood events. Flood study outputs often now include:

- draft Planning Scheme Amendments (section 10.2)
- preferred elements for a Total Flood Warning System (section 13)
- preferred options for flood mitigation measures (section 13.1)
- drafts of the relevant components of the Municipal Flood Emergency Plan (section 20).

It is important to note that not every flood study will require all these outputs. For example, in sparsely populated rural areas, the main output might be a draft Planning Scheme Amendment because mitigation infrastructure or activities on waterways, if any, are likely to revolve around individual actions. If those actions include levees around dwellings and curtilages, they will be covered through existing planning schemes. If they involve existing infrastructure on Crown land or activities on waterways, licensing arrangements will cover them (sections 13.3 and 14.1).

Case study: Corangamite Planning Scheme flood controls at Skipton

The township of Skipton straddles the Mount Emu Creek about 50 kilometres west of Ballarat where the Hamilton Highway crosses the creek. The commercial centre of the town, and many residential properties, were severely flooded in September 2010 and January 2011. The 2011 flood was the worst on record for Skipton and residents had limited information to guide them in preparing their properties for the impact.

In early 2013, Glenelg Hopkins CMA and Corangamite Shire Council worked with the Skipton community to complete the Skipton Flood Investigation. Corangamite Shire Council, the Commonwealth Government and the Victorian Government (through the CMA), jointly invested a total of \$138,900 in the project. The project showed that the construction of a physical flood barrier was not feasible – it would have required a levee more than two metres high along the entire creek frontage.

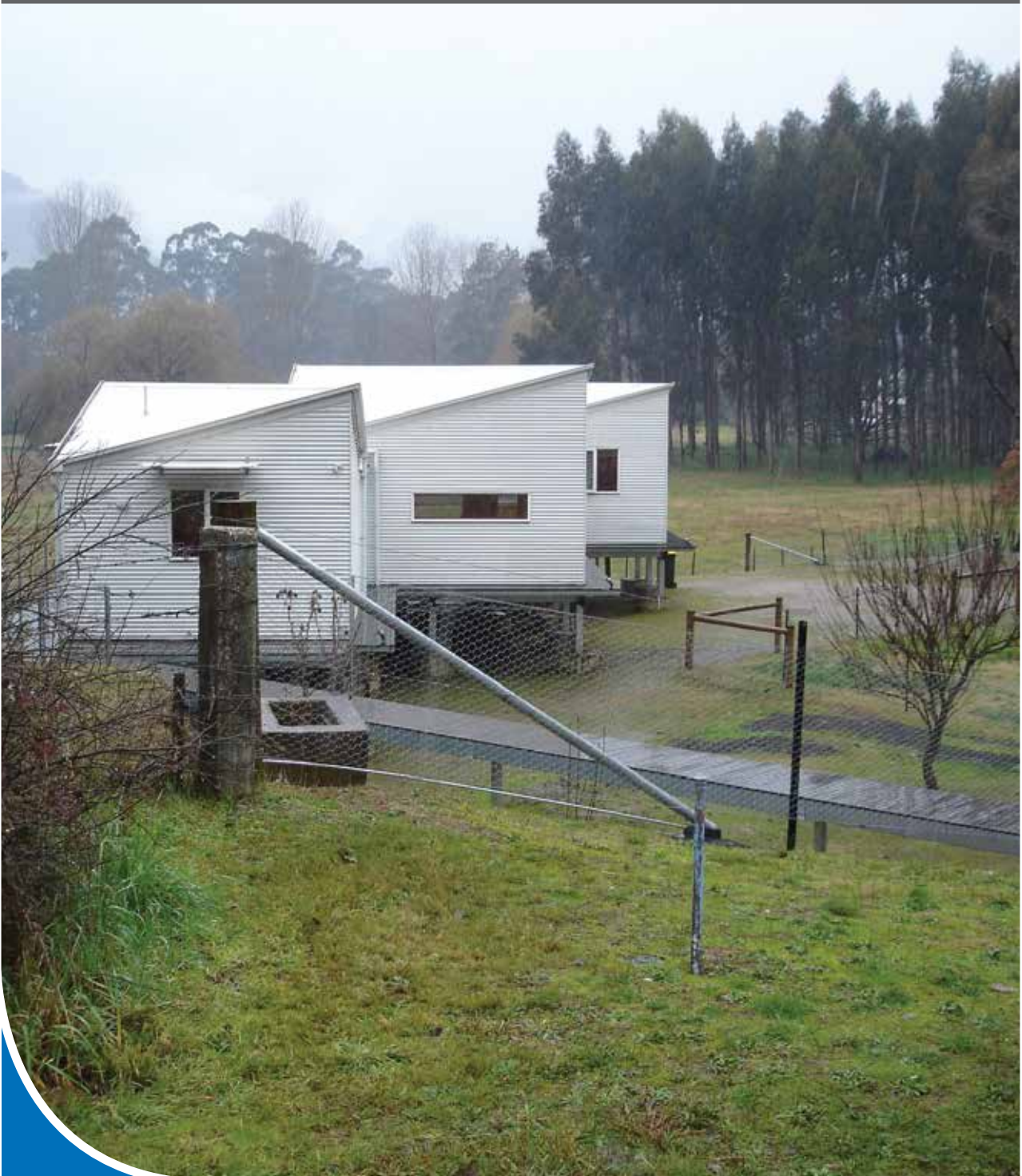
The Skipton community instead supported introducing floodplain planning controls to guide future development in the town and to help people identify areas at risk. Corangamite Shire Council and Glenelg Hopkins CMA worked together to develop controls tailored to the flood conditions at Skipton. Council moved forward with an amendment to the Corangamite planning scheme in 2013 and adopted the new controls into the scheme in early 2014.



Source: DTPLI

Section 2

Avoiding or Minimising Future Risks



House and infrastructure built up from the ground. Source: North Central Catchment Management Authority

Chapter 10: Mitigating flood risks through planning and building

All levels of government have recognised that land use planning can help to mitigate the threat from natural hazards. The Council of Australian Governments recognised in its National Strategy for Disaster Resilience that “responsible land use planning can prevent or reduce the likelihood of hazards impacting communities”, especially for new development.

The Victorian Government’s Emergency Management Reform White Paper also explains that: “Community resilience can be improved by using planning approaches that consider likely risk factors and vulnerabilities, and identify how to mitigate against those risks. Land use planning policy must fully account for a location’s risk profile to properly determine the nature and extent of new developments.”

The Victorian Floods Review (VFR) noted that land use planning and building controls were generally more cost effective than flood mitigation infrastructure, flood warning systems, education programs or emergency responses.

One of the objectives of the *Planning and Environment Act 1987* is to “provide for the fair, orderly, economic and sustainable use and development of land”. In that context, the Act also provides for “planning schemes to regulate or prohibit any use or development in hazardous areas or in areas which are likely to become hazardous areas”.

Because it is possible to predict which land is at risk of flooding, it follows that it is prudent to regulate development in those areas to ensure it is consistent with flood risk. In so doing, the aim is to avoid or minimise the increase in future flood risks.

10.1 The threshold flood risk in the built environment: the design flood event

In order to identify the areas that the planning and building systems should protect, it is necessary to decide which level of flood risk should be used. This risk is known as the ‘design flood event’.

The VFR questioned if the 1% AEP flood should still be used as the designed flood event in Victoria. The Victorian Government has determined that the 1% AEP flood is the appropriate standard to regulate and protect new development through the planning and building systems. It has also determined that emergency and community facilities (including hospitals, ambulance stations, police

stations, fire stations, residential aged care facilities, communication facilities, transport facilities, community shelters and schools) should be located outside these areas.

The purpose of planning and building regulations is to ensure that proposed new developments and redevelopments have regard for the applicable flood risk. If the risk is judged to be intolerable, a development proposal may be rejected. However, in most cases development would be subject to conditions about appropriate floor levels, the siting of the building on areas of lowest risk, the standard of building construction and, in some cases, works to divert floodwater away from a building.

The impacts of floods rarer than the 1% AEP flood (i.e. less than 1% AEP) are not regulated through the planning and building systems.

Proposed Policy 10a

- The 1% AEP flood will remain the design flood event to regulate new development and construction standards in Victoria.

10.2 Using planning systems to mitigate flood risk

There are two approaches to planning: strategic planning and statutory planning. Strategic planning relates to decisions about how land should be used in general over the short, medium and long term. Statutory planning relates to decisions on specific proposals for development.

Strategic planners can identify flood areas and help regulate development, such as the need for access to and from a property or building during a flood. These controls are then used as the basis for statutory planners to decide if an application for development meets their requirements and whether it can proceed.

10.2.1 Victoria’s land use planning system

Victoria’s land use planning system operates through planning schemes, which are subordinate legislation under the *Planning and Environment Act 1987*. Planning Schemes set out policies and provisions for the use, development and protection of land. They are legal documents prepared by the local council or other planning authorities, and approved by the Minister for Planning.

Planning Schemes must be prepared using the Victoria Planning Provisions (VPPs). The VPPs contain a comprehensive set of planning provisions for Victoria, including compulsory state and local policies and strategies, and zones and overlays used locally. This approach helps ensure that Planning Schemes are prepared in a consistent way.

10.2.2 State and regional planning

Planning Schemes include a compulsory State Planning Policy Framework (SPPF), which sets out the statewide principles, policies and strategies for how land is to be used and developed in Victoria. Planning Schemes must also be consistent with State Government's Regional Growth Plans, which are incorporated into planning schemes.

State planning policies provide the basis for land use planning, including settlements. For example, the SPPF floodplain management policy is to protect life, property and community infrastructure and also to protect areas of environmental significance and river health. This policy currently requires land affected by a 1-in-100-year flood to be identified in Planning Schemes maps and for planning decisions to avoid intensifying the impacts of flooding through inappropriately located uses and developments. This policy will be updated to reflect the 1% AEP flood.

The SPPF is currently being reviewed. A draft has been released for public comment. It will link state, regional and local planning policy to better align policy matters, ensuring local policy retains its important role. The draft framework also proposed regional level policies to guide strategic planning.

In recognition of this new direction in planning, the Victorian State Government has released Regional Growth Plans to support strategic planning at the regional level. Regional Growth Plans recognise the impacts of natural hazards, including flood, and set strategies for development to be located away from flood hazard areas and, where relevant, areas that are prone to coastal inundation as a result of climate change.

10.2.3 Local area planning

Planning Schemes contain a Local Planning Policy Framework (LPPF) that includes:

- a Municipal Strategic Statement that explains a council's objectives and strategies in exercising land-use controls in a planning scheme
- zones and overlays that regulate the use and development of land.

The VPPs include one zone (urban floodway zone) and three overlays (floodway, special building and land subject to inundation overlays) directly relevant to flood-prone areas.

In minimising or avoiding the growth of future flood risks, the role of councils is to incorporate flood provisions into their Planning Schemes. The VPPs require councils to consider flood risks when preparing Planning Schemes (strategic planning), and in making land use planning decisions (statutory planning).

Land use planning is an integral part of the optimum suite of flood mitigation measures for every flood-prone area.

Accountability 10a:

- Local councils are accountable for ensuring that their Planning Schemes correctly identify the areas at risk of a 1% AEP flood, and contain the appropriate objectives and strategies to guide decisions to help minimise or avoid exposure to the risk.

Proposed Policy 10b

- Councils with areas at risk of a 1% AEP flood must ensure that their Planning Scheme contains:
 - a Municipal Strategic Statement explaining the objectives and strategies for mitigating the risk
 - the appropriate zones and overlays.

Proposed Action 10a:

- DEPI, in consultation with local government, CMAs and Melbourne Water, will work with DTPLI to:
 - update the State Planning Policy Framework's floodplain management policy to use the 1% AEP flood as the terminology for the design flood event, replacing the current reference to the 1-in-100-year design flood event
 - review and, if necessary, update Victoria's flood-related planning controls to ensure they remain relevant to current flood risks.
- CMAs and Melbourne Water will work with relevant local councils to ensure that planning schemes use the zone and overlay which correctly aligns with the flood risk.

10.2.4 Planning for access and egress

As communities grow, it is important to consider not only the potential future damage caused by land use intensification but also the safety of the community. The VPPs require councils to consider the potential impact on the resources of emergency services. There are three major considerations:

- access by the community to evacuation routes
- capability and capacity of emergency services to undertake rescues
- ability of emergency services or other providers to re-supply properties that have been isolated by flood waters.

It is important that property buyers have a high level of certainty that they will be able to build on or develop the land. It is inappropriate to undertake due diligence on a property for flood risk, only to be later refused a permit from the council due to access and egress considerations.

A strategic approach is required that incorporates access and egress into planning decisions. Regional flood mapping, local flood studies and emergency response plans provide the opportunity for emergency services, CMAs and Melbourne Water to advise councils on access and egress issues for incorporation into their strategic plans.

This will enable a strategic approach and move away from case-by-case considerations. It will also enable emergency management agencies to provide input into land use planning without needing to review every planning application.

Accountability 10b:

- Councils are accountable for developing strategic plans for consideration of access and egress in land use planning.
- SES, CMAs and Melbourne Water are accountable for providing advice to councils so that they can make decisions about the suitability of access and egress arrangements for proposed developments.

Proposed Policy 10c:

- Councils will incorporate access and egress arrangements into their regional growth plans at a community scale using advice from SES, CMAs and Melbourne Water.

Councils also need to continue applying appropriate planning controls for areas of poor drainage and for those areas where the boundary of the floodplain cannot easily

be determined. They are also responsible for ensuring that planning controls apply to developments in low-lying areas behind levees. As discussed in section 13.1.4, this is necessary to take account of the residual flood risk caused by storm water flooding behind levees and by the overtopping of levees.

10.2.5 Existing planning coverage

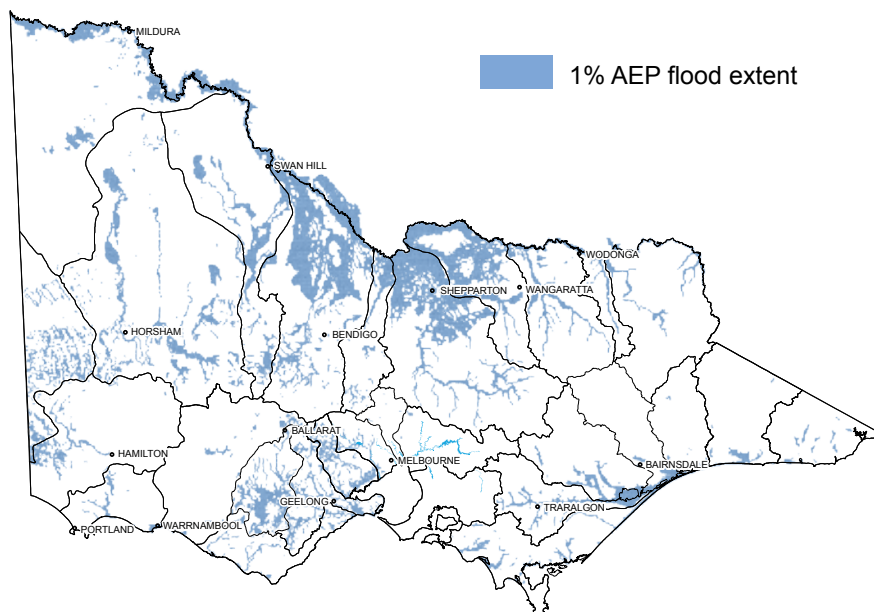
About 11.5% of Victoria's land mass is prone to a 1% AEP flood, but fortunately not all at the same time. Figure 6 shows a map of the total 1% AEP flood extent for Victoria. It excludes storm water flooding for Melbourne and other urban centres.

Only about 2.5% of Victoria is urbanised, but this is home to most of the population. About 75% of Victorian's live in Greater Melbourne alone. Only 5% of Victoria's urban areas are affected by 1% AEP flooding.

While Victoria's flood databases indicate that 11.5% of the Victorian landmass is prone to a 1% AEP flood, our planning system records 7.5% of the landmass as being covered by Flood Overlays. This leaves 4% of the landmass without appropriate Planning Scheme Overlays.

MW and the CMAs currently provide important functions in providing flood advice to local councils as floodplain management referral authorities under the *Planning and Environment Act 1987*. Those functions are linked to Section 202 of the *Water Act 1989*. These functions are enabling, but they remain paramount to ensure that new land use and development proposals do not unduly add to past legacy flood problems, and that emergency management planning and response decisions take into account the flood risk.

Figure 6: Portion of Victoria affected by 1% AEP flood



10.2.6 Streamlining land use planning

Recommendation 86 of the Victorian Floods Review (VFR) called for Victoria to “adopt a strategy to expedite incorporation of updated flood mapping or modelling into planning schemes”.

As discussed in section 4, land use planning has not realised its potential in minimising or avoiding the growth in future flood risk. Until now, it has been subject to institutional capacity: including flood overlays into Planning Schemes depends on the capacity and willingness of local councils for its implementation. Where that capacity and willingness has been deployed, land use planning is working well. Melbourne Water (MW) has made it possible for land use planning to work throughout metropolitan Melbourne. It also works well in regional areas that are subject to frequent flooding. However, there are large areas of rural and regional Victoria that remain inadequately covered.

DEPI, the CMAs and MW must help resolve this issue by collaborating with local councils to overcome remaining capacity issues. They must also help to identify and use any potential economies of scale in the panel processes that are a necessary part of planning scheme amendments.

The flood study process has evolved significantly to help address the capacity issues. For example, as explained in section 9.3, flood study outputs now include draft planning scheme amendments.

DEPI is also piloting a methodology to produce regional flood studies. Digital elevation data, suitable for flood modelling, has been collected for all major floodplains in Victoria; five catchment-scale pilot projects (due for completion in mid-2014) are being used to test a range of methodologies for producing regional flood studies. Once the pilot projects are finished, catchment-scale flood mapping will progressively be completed for the rest of Victoria’s major floodplains.

The outputs from future regional flood studies will include draft planning scheme amendments.

Proposed Action 10b:

- DEPI will include the requirement to draft planning scheme amendments as part of flood study guidelines.

Regional floodplain management strategies (section 9) will document and report on all townships with known flood risks; they will also document and report on those townships that do not have planning controls to regulate any use or development within the 1% AEP flood event.

The implementation plans coming out of regional strategies will seek to either:

- help convert existing flood study data into planning scheme amendments; or
- conduct new flood studies to provide draft planning scheme amendments.

Proposed Action 10c:

- DEPI will work with local councils to streamline the processes involved in converting flood study outputs into appropriate Municipal Planning Scheme amendments.

Where a township with identified flood risks has been provided with a draft planning scheme amendment, but is not adequately covered by appropriate planning controls – and there are no processes in train to rectify that situation – the issue may be escalated to the relevant Regional Emergency Response Planning Committee by any of the agencies involved in floodplain management or flood emergency management in the region. If that committee is unable to resolve the issue, it may then escalate to the Risk and Resilience Sub-committee of the State Crisis and Resilience Committee. This approach is in keeping with the importance placed on land use planning by the VFR.

10.3 The building system

Building work in Victoria is controlled under the *Building Act 1993* and the Building Regulations 2006 (the Regulations). One of the objectives of the Building Act is to protect the safety and health of people who use buildings. The Regulations adopt the Building Code of Australia (BCA) for the minimum technical standards for the construction of buildings. States and Territories have committed to support a nationally consistent BCA and to limit variations wherever practical.

While certain developments require a planning permit, a building permit is required for the construction or significant alteration of most buildings in Victoria. Where the site for proposed building work is in an area liable to flooding and a planning permit is not required, a building permit applicant must obtain the report and consent of the local council.

Under this process, local councils must consult with the relevant CMA or Melbourne Water.

The Regulations define when land is in an area liable to flooding. Such areas can be determined from planning schemes or from descriptions on a certified or sealed plan of subdivision. They can also be otherwise designated by a local council.

On 1 May 2013, the Australian Building Codes Board introduced technical standards in the BCA for flood areas. These standards require certain new building work to be designed to resist structural damage during a flood, taking into consideration the expected velocity of floodwaters.

It has not been practical to map velocities across all floodplain areas in Victoria. As part of a building permit application, the builder or designer must provide evidence to the relevant building surveyor that the building design complies with the BCA. Evidence must be based on advice on the flood level and water velocity of the site from the relevant CMA or a hydraulics engineer.

Proposed Policy 10d:

- DEPI, DTPLI and the Victorian Building Authority will work together and continue to monitor the current system with the aim that the flooding provisions of the Building Code Australia and the Regulations are effective and can be readily applied by building practitioners in Victoria.

Chapter 11: Planning around coastal inundation

The Victorian Coastal Hazard Guide (2012) says coastal inundation: “... may occur during extreme weather, when higher water levels cause seawater to flood land that is normally dry. The primary causes of inundation are storm surges combining with high tides (storm tides) and extreme wave events. Flooding can be worsened in estuaries by rainfall in coastal catchments.”

The Guide goes on to say: “Additionally, the effects of climate change are contributing to a progressive permanent increase in sea level that will increase the extent and duration of storm-induced coastal inundation.”

This section of the strategy focuses on what can be done to deal with coastal inundation.

11.1 The Interaction between coastal processes and coastal flooding

The forthcoming edition of *Australian Rainfall and Runoff (ARR)* will look at the interaction between coastal processes and severe weather events. It will look at the interaction between storm-induced flood peaks and peak ocean or peak estuarine conditions.

Flood studies, and therefore flood models, need to consider the probabilities of these events occurring at the same time. This is similar to the situation in inland areas where a flood study might have to deal with the probabilities of two or more streams, from different catchments, being in flood at the same time.

It is difficult to separate coastal flooding (inundation) from other coastal processes (shoreline erosion and recession) that modify landforms. For one thing, erosion and recession may be caused by inundation, wind action or wave action. Conversely, erosion can lead to the inundation of low-lying areas.

Many issues surrounding coastal processes are outside the scope of this strategy. The Victorian Coastal Strategy 2008 (VCS) has primacy when it comes to coastal issues. It envisages regional and local adaptation plans being produced to enable the strategic management of coastal hazards to public and private property. Its policy is to: “Avoid development in sand dunes, in low lying coastal areas and in identified coastal hazard areas susceptible to inundation (both river and coastal).”

The VCS identifies the need to clarify ‘sea level rise’ predictions for use in local council planning decisions. The VCS includes a number of actions to help coastal communities understand and respond to the risks associated with ‘sea level rise’ and coastal inundation. These actions include:

- developing Regional Coastal Plans that, among other things, identify areas of coast land at risk from erosion and inundation and consider adaptation responses
- supporting local councils to understand the risks of ‘sea level rise’ and develop coastal adaptation plans to inform the community of how the risk of coastal flooding will be managed.

11.2 Identifying risks at the regional level

Government’s *Future Coasts* program developed tools to provide an understanding of coastal risks under existing climatic conditions, and future scenarios. These tools included high-resolution coastal digital elevation models, coastal inundation mapping, the *Coastal Hazard Guide*, the Coastal Asset Information Library, and four pilot local coastal hazard assessments.

DEPI’s *Future Coasts* coastal inundation mapping will soon be uploaded to the Victorian Flood Database. This mapping is fit-for-purpose for strategic planning at the regional scale; it identifies areas that may be affected by flooding in the future so that they can be prioritised for further assessment.

Those parts of DEPI responsible for coastal management will continue to work with Victoria’s Regional Coastal Boards to prepare Regional Coastal Plans that will establish these priorities. Those plans will result in rolling work plans to address the priorities as funding becomes available. DEPI is also preparing regional coastal risk assessments to address risks to key state coastal assets.

Proposed Action 11a:

As outlined in the Victorian Coastal Strategy, DEPI will:

- support the development of Regional Coastal Plans to inform coastal adaptation plans in ways that will, among other things, identify areas of coastal land at risk from erosion and inundation and consider adaptation responses
- develop regional coastal risk assessments to strategically and consistently identify and prioritise coastal hazards and manage risks to key state coastal assets.

11.3 Supporting adaptation responses

Adapting to climate change involves reducing risks, increasing resilience and taking advantage of opportunities. Everyone in coastal communities needs to play a part in adapting to coastal change in this way. Councils and land managers need to make wise land use decisions; they need to strike a balance between current use and development opportunities and the longer-term risks of property damage

The Victorian Government is working closely with local councils to produce local coastal adaptation responses. The outcomes of four pilot local coastal hazard assessment projects (in Port Fairy, the Bellarine Peninsula, Western Port and the Gippsland Lakes), and related adaptation projects, will be used to guide the practical application of adaptation principles.

Proposed Policy 11a:

- DEPI will support councils wishing to strengthen their community's capacity to adapt to the effects of coastal flooding.

Proposed Action 11b:

- DEPI will:
 - work with councils to develop adaption responses from the hazard assessment pilot projects
 - identify other areas where this process can be used.

Councils can develop adaptation plans to strategically assess and manage the risks of coastal hazards (like erosion and inundation). Such plans:

- involve the community
- guide Planning Schemes – including updating what areas are appropriate or not appropriate for development
- assess options for managing inundation and erosion
- generate a better understanding of the issues to be faced now and in the future.

Proposed Policy 11b:

- Councils will prepare coastal change adaptation plans in consultation with their local communities.

Where adaptation plans indicate that mitigation infrastructure is required for public benefit then, in line with government policy, local beneficiaries will contribute to the capital costs in cost-sharing arrangements with the Victorian and Commonwealth Governments. The local beneficiaries will be responsible for the ongoing management and maintenance costs.

Benefit-cost analysis will determine the priority surrounding government contributions. The total costs used in those assessments will include the costs of third-party impacts, such as reduced sand replenishment on other beaches.

Adaptation plans need to be regularly updated in the light of new data, new knowledge and emerging risks.

11.4 Planning for rising sea levels

While the CMAs and Melbourne Water (MW) have applied their skills to assessing the effects of inundation from the sea on coastal development, they do not have the resources to hold primary responsibility for assessing the effects of erosion and landform changes on coastal development. Therefore, there needs to be clear demarcation between coastal flooding issues and coastal erosion issues.

As outlined in section 10, the CMAs and MW will work in active partnerships with councils to develop regional priorities for riverine and estuarine floodplain management. For coastal flooding, however, the CMAs and MW will have a supporting role; councils wishing to prepare adaptation plans, conduct flood studies or amend Planning Schemes in response to the risk of coastal flooding can seek assistance from DEPI and the CMAs or MW.

Where councils amend their Planning Schemes to show land subject to inundation caused by seawater, the CMAs and MW will act as referral authorities for recommendations on land use planning.

The State Planning Policy Framework (SPPF) documents strategies “to plan for and manage the potential coastal impacts of climate change” in the following terms:

- “In planning for possible sea level rise, an increase of 0.2 metres over current [1% AEP] flood levels by 2040 may be used for new development in close proximity to existing development (urban infill).”
- “Plan for possible sea level rise of 0.8 metres by 2100, and allow for the combined effects of tides, storm surges, coastal processes and local conditions such as topography and geology when assessing risks and coastal impacts associated with climate change.”
- “For new greenfield development outside of town boundaries, plan for not less than 0.8 metre sea level rise by 2100.”

Accountability 11a:

- DEPI, in consultation with DTPLI, is accountable for providing policy and guidelines on coastal land use planning issues, coastal flooding issues and public land use.
- DTPLI is accountable for ensuring that those policies are incorporated into the State Planning Policy Framework.

Proposed Policy 11c:

- Councils will make locally based decisions about managing the risk of coastal flooding – informed by relevant government policies, advice from local communities and advice from subject matter experts.

DEPI and MW have both produced guidelines to ensure that the SPPF strategies can be applied to Municipal Planning Schemes using clear and consistent principles. Those guidelines allow for discretion at the regional and local levels.

For example, with regard to the potential rise of 0.2 metres, the aim is for planning controls to include an additional freeboard allowance of at least 0.2 m on top of existing freeboard requirements (unless 0.2 m has been added to the 1% AEP flood levels).

The aim is to provide flexibility for coastal communities to remain viable by enabling appropriate infill development over the next few decades, with future adjustments made as certainty on degree of sea level rise increases. Adaptation planning is seen as the medium to long-term solution to managing the impacts of higher sea levels. By contrast, if the intention is to transform land use from rural to urban purposes, longer-term planning controls should be used and the proposal should be assessed against long-term risks from projected sea level rise of not less than 0.8 m by 2100.

In providing advice to councils, the CMAs and MW have discretion to recommend more or less stringent freeboard requirements in some circumstances. For example, they might do so if the proposal were to result in a small increase in flood risk relative to existing risks (e.g. small building extensions). Similarly, they might waive the requirements where flood damage was seen as an acceptable business risk – this might apply to some industrial and commercial land uses.

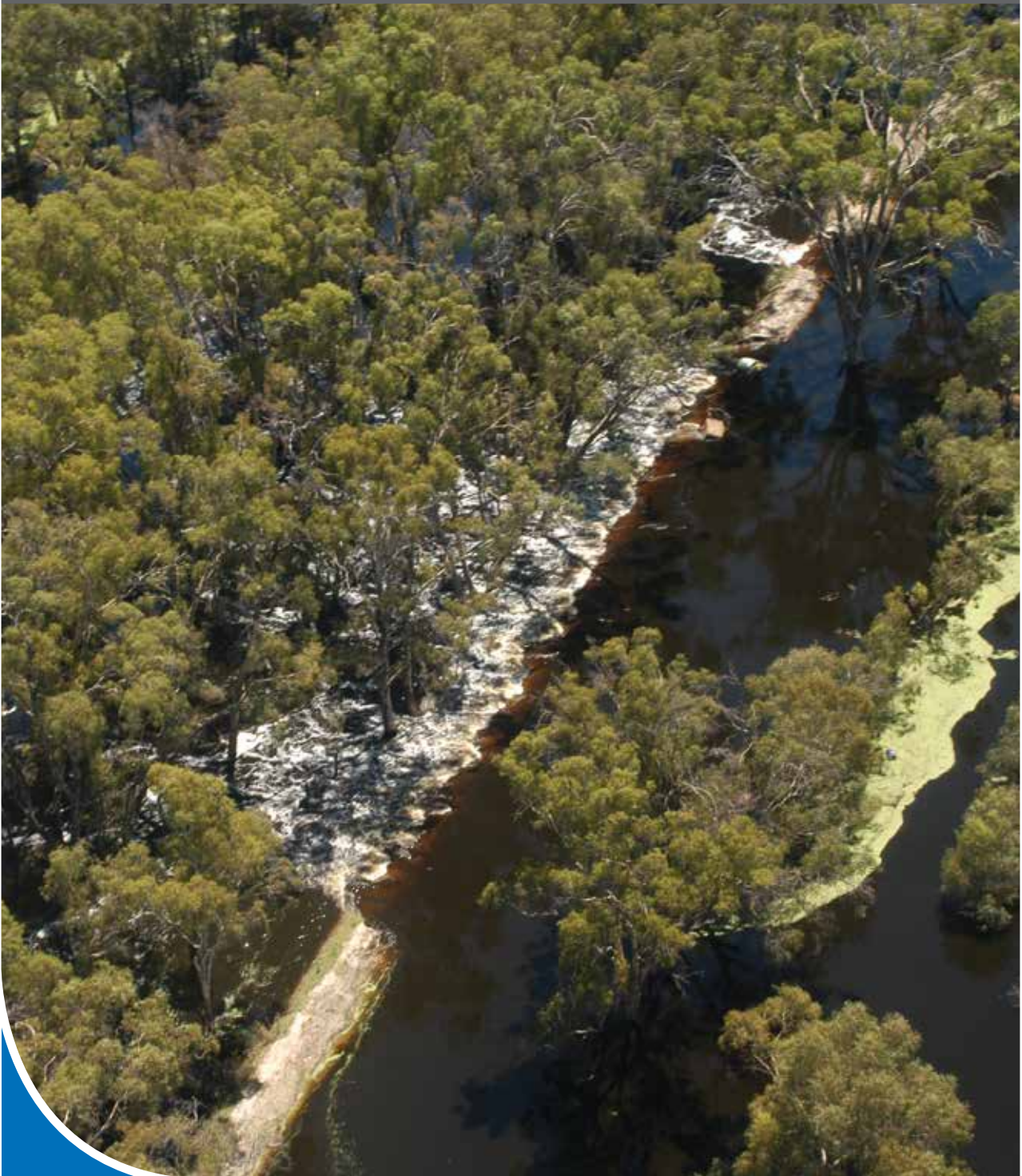
Accountability 11b:

- DEPI and Melbourne Water are accountable for maintaining guidelines on how to apply those clauses of the State Planning Policy Framework that relate to projected rises in sea level.

DEPI’s guidelines for dealing with sea level rise apply unless a council’s adaptation plan makes specific alternative arrangements. Adaptation plans will provide the medium through which communities can plan for the complexities of coastal change – both for infill development in existing settlements and for a change from rural to urban land uses.

Section 3

Reducing Existing Risks



Breach of levee at Benjeroop, January 2011. Source: North Central Catchment Management Authority

Chapter 12: Flood warnings

A specific flood is only manageable if we can make real-time assessments about its behaviour and its consequences. Armed with such assessments, it is possible to coordinate appropriate responses, and advise and educate communities.

Flood warnings can help local communities mitigate flood damage. Effective flood warnings provide communities, and emergency management agencies, with information about when flooding may occur, the likely severity of flooding and what to do to reduce damages.

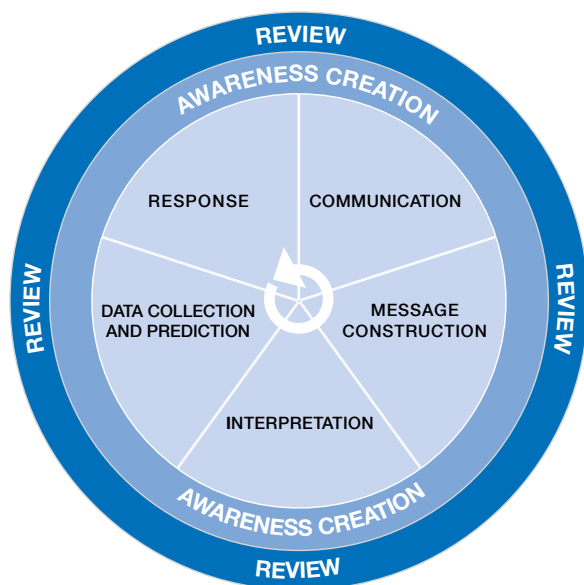
12.1 The Total Flood Warning System concept

A Total Flood Warning System (TFWS) encompasses all the elements necessary to maximise the effectiveness of the communities' and agencies' response to floods. These elements are illustrated in Figure 7. The elements of the TFWS each play a part in the effectiveness of flood warnings; they each help to reduce damages to property and threats to life.

Victoria's TFWSs are designed and implemented in the context of the national flood warning arrangements outlined in section 6. Each locally specific TFWS will be designed and implemented in accordance the relevant regional floodplain management strategy (section 9) or local flood study.

The TFWS concept is explained in the Australian Emergency Management Manual Series, *Manual 21 Flood Warning*.

Figure 7: The elements of a Total Flood Warning System



All Victorian communities receive a flood warning service; it consists of weather-related warnings such as Flood Watches and Severe Weather Warnings delivered by BoM. These services provide 'heads up' advice on weather conditions that have the potential for heavy rainfall and flooding. On top of this, BoM's website also provides near real-time river height data and rainfall data. This information allows people to make their own judgements about the rates of change and the potential for local consequences during a flood.

All communities also receive general safety messages, like "do not drive through floodwaters" from SES. Everyone also has access to guidance on appropriate flood responses. For example, SES issues *FloodSafe* guides to support local communities in preparing for and responding to floods.

Existing communities with high potential for flood damage receive more sophisticated TFWS services. These can include local predictions about the rise and fall of floodwaters, details on the roads and properties likely to be inundated and local advice about how to prepare for and respond to predicted floods.

Regional floodplain strategies and local flood studies may identify additional communities where more sophisticated TFWS services are warranted. The ongoing review of regional floodplain management strategies will enable continual assessment of the flood warning services to communities.

This strategy sets the framework to assess, establish, revise, operate, maintain and review TFWS services across Victoria.

12.2 Assessing TFWS service at the state, regional and local level

The 2010-11 floods exposed serious deficiencies with the management of TFWS services; no one agency had overall accountability for the coordination of and performance reporting on the TFWS service at the state level. To rectify this, the Victorian Government has made DEPI accountable.

The first step in meeting this accountability is to assess existing TFWS services. The second step is to determine whether or not the assessed TFWSs meet community needs.

DEPI is preparing a statewide framework to assess both TFWS services and community needs. Melbourne Water (MW) and the CMAs will use this framework in preparing their regional floodplain management strategies (section 9) and in local flood studies. Those regional strategies and local studies will be the primary vehicles for assessing current local and regional TFWS services, and comparing them to community needs.

In making these assessments, the active collaboration of SES, BoM, local councils, water corporations, local communities, and other stakeholders will be sought as required.

The rolling three-year implementation plans coming out of the regional floodplain management strategies will inform a state TFWS service development plan. It will be prepared by DEPI in consultation with SES, BoM, MW, CMAs, local government, water corporations and other stakeholders as required.

12.3 Matching TFWS services with community needs

A local flood study, or a regional floodplain management strategy, will assess the community needs for a TFWS service. This might trigger a need to establish a new TFWS service or change an existing TFWS service.

The CMAs and MW will co-ordinate the assessment and implementation of TFWS services at the local and regional level. DEPI will document TFWS services in the state TFWS service level specification. This specification is in accordance with VFR Recommendation 3.

The relevant agencies' roles and responsibilities in developing or improving the service will be as follows:

Data collection network: The required network of river height and rainfall gauges will be delivered through the relevant Regional Water Monitoring partnership (outside Melbourne) or MW's equivalent monitoring services arrangements. The network will meet the needs of the flood prediction service providers (BoM or MW as appropriate). BoM and MW will make data from the network publicly available in close to real time as practicable. The capital cost for new or upgraded networks will be shared between the Commonwealth and Victorian Governments.

Prediction service establishment: MW is responsible for flood prediction within its region and provides flood warnings appropriate for its catchment to BoM (for dissemination). BoM provides flood prediction services to the rest of Victoria.

MW or BoM will develop the appropriate services. The Victorian Government will, in accordance with BoM's cost-recovery policy, fund the establishment of forecast prediction services where required.

BoM will revise its Service Level Specification for Flood Forecasting and Flood Warning Services to record changes in the prediction services. This will be done in consultation with the Victorian Flood Warning Consultative Committee.

Interpretation (flood mapping and flood behaviour assessment): Local flood studies will deliver the flood mapping for use in flood behaviour assessment, flood response planning, and flood awareness raising. DEPI will incorporate flood mapping and flood behaviour material into the flood intelligence platform.

Message construction and dissemination: BoM and MW will develop appropriate flood warning messages. BoM and MW will consult with SES to determine appropriate dissemination channels.

SES will develop appropriate flood bulletin messages using available flood behaviour and intelligence material. SES will consult with local councils and other emergency services agencies to determine appropriate dissemination channels for flood bulletins. DEPI will consult with SES to ensure that appropriate information for messages and bulletins can be accessed through the flood intelligence platform.

BoM will revise its Service Level Specifications for Flood Forecasting and Flood Warning Services to reflect the warning product and dissemination.

BoM will revise its Service Level Specifications for Flood Forecasting and Flood Warning Services to reflect the warning product and dissemination.

Flood response planning and community awareness: SES will develop the required flood response plans and community awareness material in conjunction with local councils.

Case study: Shepparton Mooroopna flood warning system

Greater Shepparton City Council and Goulburn Broken CMA produced the Shepparton Mooroopna floodplain management study in 2002. The study found around 6,500 properties would be affected by a 1% AEP flood, at a cost to the community of more than \$54 million.

The study concluded that structural mitigation would cause higher flood levels for unprotected properties.

Instead the plan recommended that the costs of flooding could be cut by up to 60% if residents received accurate, early warnings. In 2006, Greater Shepparton City Council moved toward implementation of the Shepparton Mooroopna Flood Warning and Emergency Management Project, with a joint investment of \$455,000 from the Victorian Government, the Commonwealth Government and the Council.

The plans final elements were implemented in 2011 for a total of \$340,000 shared in the same way.

Shepparton and Mooroopna residents now have access to telephone- based flood alerts, flood height warnings linked to local river gauges, and property- specific flood charts to translate into a personal flood action plan.

Case study: Building a community flood monitoring system for Wimmera communities.

Rural communities in the Wimmera region reported feeling uninformed when homes, farmland, equipment and fencing were severely damaged by the January 2011 flood.

Residents helped where they could by telephoning the Incident Control Centre in Horsham to report rising river levels. But with no system in place to compare local observations with river gauge levels, authorities struggled to interpret this information.

In response to community concerns, Horsham Rural City Council (RCC) instigated a project to train volunteers to monitor flood levels and liaise with emergency organisations. Working with Wimmera CMA and the local Indigenous Groups, they installed a system of flow level gauge boards at easily accessible locations along the river. The boards have information to help observers understand how to report flood levels accurately. To help with this, the boards include marks showing the highest levels reached during past floods.

Each gauge location also provides key emergency management contact information. The CMA and Horsham RCC have trained a network of Community Flood Champions who can be called on during a flood to report flood level changes at their nearest river gauge.

With an investment of \$25,000 made available through the State Government's Community Recovery Fund, residents in the Wimmera can now take an active part in providing flood warnings for their communities.



Wimmera River at Faux's Bridge. Source: Wimmera Catchment Management Authority.

12.4 Operating and maintaining a TFWS service

The relevant agencies' roles and responsibilities in operating and maintaining the service will be as follows:

Data collection network infrastructure: The river height and rainfall gauging network infrastructure will be maintained through the relevant Regional Water Monitoring Partnership (involving DEPI, local councils, CMAs or MW, and other water corporations). Local councils will fund the maintenance of the TFWS-related components. DEPI will manage the Regional Water Monitoring Partnership contracts, and MW will manage equivalent contracts.

Flood prediction service maintenance: BoM (outside the Port Phillip and Western Port region) or MW (within the Port Phillip and Western Port region) will maintain the prediction services at their own cost for the locations defined in the Service Level Specification. Maintenance includes continually improving prediction techniques.

Interpretation (flood mapping): Local flood studies will update flood mapping. DEPI will include updated flood mapping and flood behaviour information into the flood intelligence platform.

Message construction and dissemination: BoM and MW will maintain appropriate flood warning messages and associated dissemination channels for locations noted in the BoM Service Level Specification for Flood Forecasting and Warning Services. SES will maintain its dissemination channels for flood bulletins. DEPI will maintain the flood intelligence platform to enable appropriate information for messages and bulletins to be accessed. Local councils will maintain locally specific dissemination systems.

Flood response planning and community awareness: SES will maintain flood response plans and community education material. CMAs and MW will supply SES with any significant updates of the flood mapping and flood behaviour information.

Accountability 12a:

- DEPI is accountable for maintaining and continually improving the framework for assessing TFWS services and the guidance on community needs.
- DEPI is accountable for ensuring TFWS services that are tailored to meet local requirements are in operation for flood-prone communities in Victoria.
- SES is accountable for making sure that the development of TFWS services includes processes to incorporate local knowledge
- CMAs, in consultation with the community and BoM, are accountable for identifying the local triggers for declaring appropriate flood class levels (minor, moderate or major).
- Melbourne Water and the CMAs are accountable for the assessment and implementation of TFWS services to align with community needs in their regions.

Proposed Action 12a:

- DEPI will:
 - establish a framework to assess TFWS service and guidance on community needs
 - prepare a rolling three-year State TFWS development plan informed by the rolling three-year implementation plans coming out of regional floodplain management strategies and local studies.

12.5 Review

The Office of Emergency Services Commissioner (OESC) has developed a TFWS assurance regime to meet its obligation to develop an audit framework for the TFWS. The assurance regime includes:

- a mapping process to describe the TFWS
- a framework to facilitate the collection of consistent, relevant and quantifiable information or data to support rigorous monitoring and assessment of the performance of the TFWS
- a three-year schedule of assurance activities, including proactive and reactive reviews to test all aspects of the TFWS.

Apart from the proactive reviews at the heart of the TFWS assessment framework, DEPI will also need to monitor and review how each TFWS performs when it is needed. To that end, the relevant TFWS will, as a matter of course, be reviewed after a major flood.

Proposed Policy 12a:

- After each significant flood (a flood involving the inundation of dwellings or commercial buildings), the local Total Flood Warning System will be reviewed.

Proposed Action 12b:

- Following a significant flood (as defined in the relevant regional floodplain management strategy) each CMA or Melbourne Water will convene a review of the local Total Flood Warning System involving all agencies accountable for providing input to the relevant Total Flood Warning System.

Chapter 13: Flood mitigation infrastructure

The 2010-11 floods revealed serious deficiencies in the management arrangements for flood mitigation infrastructure outside Melbourne. Responsibilities were blurred between CMAs and local councils, and accountabilities were not assigned consistently across the state.

Notwithstanding those problems, a number of local councils, together with their communities, have been proactive in leading activities to reduce flood risk.

The benefits of well-maintained flood mitigation infrastructure were demonstrated in the 2010-11 floods. Levees were constructed in the towns of Kerang and Nathalia in response to previous large floods and, importantly, those levees had been regularly maintained. As a result, both towns were spared extensive flood damage. Lessons from these floods have led to both councils taking measures to reinforce their flood defences. In recognition of public benefits of these levees, the State and Commonwealth Governments shared the construction costs with those councils and the councils took responsibility for ongoing maintenance. This approach has successfully been applied since the 2010-11 floods, for example in Creswick.

Unfortunately, these arrangements have not been applied consistently across the state. There are a number of fundamental problems inherent in the current arrangements including:

- Uncertainty that mitigation infrastructure would perform to its design standards in a flood (if indeed that standard is known)
- The benefits of the mitigation works are not well understood and those benefits do not necessarily match expectations
- Emergency response agencies often lack sufficient information on levee standards to allow them to predict whether or not a levee is likely to fail, therefore they cannot factor this consideration into their flood bulletins
- Concerns that downstream flood impacts are worsening as a result of floodwaters being channelled by upstream levees.
- Insurers are assuming, in the absence of reliable information, that flood mitigation infrastructure is not in place – because it is not owned or maintained – and therefore premiums are unduly higher than appropriate.

The Victorian Government is determined to remove that uncertainty and inconsistency in management. It wants to instil robustness into the framework for managing flood mitigation infrastructure. The government is determined that the lessons and management arrangements in place for Kerang and Nathalia should be seen as ‘best practice’ and that this approach of cost sharing between governments and local communities will be adopted for urban flood mitigation infrastructure.

To that end, the relevant accountability arrangements and policy settings for the future are summarised below. The practical implications associated with implementing these policies are outlined in sections 13.1 and 13.2.

Case study : Establishing flood mitigation infrastructure in Creswick

Creswick is located at the confluence of Creswick and Slatey Creeks; it was flooded four times between September 2010 and February 2011. The flooding was extensive in September 2010 and January 2011.

In February 2011, the Victorian Government moved to help the local community develop and implement a flood mitigation plan. Funding was made available to clear creek blockages and to increase the town’s resilience to flooding.

Hepburn Shire Council and North Central CMA worked together and consulted extensively with the Creswick community to capture

the local understanding of the floods’ impacts on the town. Local knowledge was combined with technical information, and works were designed to ensure that if a flood the size of January 2011 hit the town again the impacts would be much lower.

Taking advantage of funding available through the Victorian Government’s FloodZoom initiative and the Australian Government’s Natural Disaster Resilience Grants Scheme, Hepburn Shire Council started implementing the flood mitigation plan in 2013. Levee bank and creek works were started that year and are due to finish in 2014.

Hepburn Shire Council, the Victorian Government and the Commonwealth Government shared the total capital costs of \$650,000.

Stage two implementation is scheduled for 2014/15 with VicRoads providing design and construction services to replace two road crossings on the creek. The total capital costs of \$798,265 will again be shared between the Shire and the Victorian and Commonwealth Governments



A recently constructed earth levee blends into the landscape of this riverside park in Creswick.



Levees can take different forms – this wall is designed to fit along a narrow strip of public land, and to look appealing for overlooking properties.

Source: Simone Wilkinson

Proposed Policy 13a:

- All future large-scale flood mitigation infrastructure outside Melbourne Water's region will be implemented as Water Management Schemes under the Water Act¹ (unless there are demonstrated benefits associated with alternative formal arrangements) (see section 13.1).
- Flood mitigation infrastructure outside Melbourne Water's region that is not currently subject to formal management arrangements will remain that way unless the relevant council determines that the infrastructure should be brought into formal management arrangements (see section 13.2).
- Where a council outside Melbourne Water's region determines, in consultation with its local community, that existing large-scale flood mitigation infrastructure is necessary to reduce existing flood risks, that infrastructure will be brought into formal management arrangements and implemented as Water Management Schemes (unless there are demonstrated benefits associated with alternative formal arrangements) (see section 13.2).
- The costs of designing and building future large-scale flood mitigation infrastructure for urban areas outside Melbourne Water's region will be shared equally between the Commonwealth Government, the Victorian Government and the relevant local councils (see section 13.1.3).
- The costs of restoring or upgrading existing large-scale flood mitigation infrastructure to bring it into formal management arrangements will, for urban areas outside Melbourne Water's region, be shared equally between the Commonwealth Government, the Victorian Government and the relevant local councils (see section 13.2.3).
- The maintenance and management of all flood mitigation infrastructure accepted as a Water Management Scheme by the Minister for Water will be funded by beneficiaries (through relevant local councils) and will be subject to third-party auditing arrangements to ensure it continues to be maintained (see section 13.1.3).

13.1 Establishing new flood mitigation infrastructure

The regional floodplain management strategies outlined in section 9 will identify areas where flood mitigation infrastructure is a priority for investigation.

The starting point is a flood study (as described in section 9.3). A key output of any flood study will be consideration of the options for flood mitigation infrastructure.

It is open to Melbourne Water (MW), the relevant council or a CMA to initiate a flood study either individually or jointly. When a council takes the initiative, MW and the CMAs are expected to provide technical support. Flood study priorities will be outlined in regional floodplain management strategy or in reviews of flood events.

13.1.1 Establishing Water Management Schemes

The Victorian Government's clear preference is for large-scale flood mitigation infrastructure to be designed and implemented as Water Management Schemes under the Water Act.

Proposed changes to Victoria's water legislation will mean that the liability associated with any failure of flood mitigation infrastructure approved and implemented as a Water Management Scheme will be limited in a similar fashion to the liability that currently applies to a dam managed by a water corporation. Flood mitigation infrastructure managed under other arrangements would be subject to wider criteria for assessing liability.

Community engagement is vital to the successful implementation of flood mitigation infrastructure. Communities must be consulted to allow their concerns, their local knowledge and their ideas about management options to be considered.

In floodplain management, there are always trade-offs between benefits for the community as a whole and the costs associated with reducing risk. It is important that management options are carefully thought through, supported by technical information and that any potential third party impacts are considered and appropriately managed.

Victoria's legislation provides for an extensive community consultation process to facilitate the design and construction of flood mitigation infrastructure. The processes involved in establishing Water Management Schemes are necessarily demanding. In the interests of timeliness, these processes should be begun in parallel with the commissioning of the associated flood study.

¹ Changes are proposed to streamline the process around Water Management Schemes in the Water Bill Exposure Draft 2014. This does not impact on the intent of this policy.

Proposed Policy 13b

- DEPI will provide assistance to councils and other authorities to help them develop and implement Water Management Schemes.

13.1.2 Management framework for flood mitigation infrastructure

Few councils have extensive experience in designing and managing flood mitigation infrastructure. It is important for DEPI to provide guidance on seeking the relevant skills and expertise for the design, construction and management of such infrastructure.



Kerang protected from flood waters by flood mitigation infrastructure. Source: Mallee Catchment Management Authority

Accountability 13a:

- DEPI is accountable for maintaining a management framework for flood mitigation infrastructure.

Proposed Action 13a:

DEPI will develop and maintain management guidelines for flood mitigation infrastructure. These will include:

- guidance on the location of flood mitigation infrastructure (as outlined in the Victorian Waterway Management Strategy, when flood studies consider new levees, they should, as far as practicable, be located to minimise the impacts of high-energy flows)
- guidance on developing levee management and maintenance arrangements
- reference to inspection and auditing requirements and provision for third party inspections
- information and guidance on the use of temporary and demountable levees.

DEPI’s guidelines will not be prescriptive. It is important to allow scope for innovation and continual improvement in the development of cost-effective flood defences. The guideline will mainly be concerned with assurance that those defences will not fail to perform the job they were designed to do. Flood-prone communities, through their councils, will be free to choose the design flood event for those defences; this may be for floods more frequent than the 1% AEP flood event used for land use planning.

13.1.3 Cost-sharing arrangements

The Victorian Government’s expectation is that the costs to prepare and implement Water Management Schemes – specifically excluding ongoing management, maintenance and auditing costs – will, on a priority basis, be shared equally between the Commonwealth Government, the Victorian Government and the relevant local council.

Commonwealth and Victorian Government contributions to the capital costs of large-scale flood mitigation infrastructure to protect urban areas will be contingent on the local beneficiaries, through their local council, being committed to meeting the ongoing management, maintenance and auditing costs.

The benefits of avoiding disruption to the functioning of urban areas often extend throughout the region’s economy. Flood mitigation infrastructure intended primarily to benefit urban areas may also deliver benefits to rural areas. For these reasons, it is appropriate that local council raise the necessary revenue across its municipality.

The Victorian Government will work with local government to determine further guidance on cost sharing arrangements if required.

13.1.4 Planning controls behind formally managed levees

Even if there is no overtopping, the lowest-lying areas behind levees will still be subject to stormwater flooding – especially if there is a breakdown in the drainage and pumping systems designed to keep those areas dry. Councils are responsible for ensuring that their Planning Schemes help to minimise or avoid the growth in the risk of flooding in the lowest-lying parts of those areas protected by levees.

Unless the formally managed levee has been designed to protect against the 1% AEP flood event, including suitable allowance for freeboard, the planning controls outlined in section 10 should continue to apply to new developments.

Accountability 13b:

- Councils are accountable for ensuring that appropriate planning controls remain in place for areas behind levees that have not been designed to protect these areas against a 1% AEP flood.
- Councils are accountable for managing the consequences of stormwater flooding in areas protected from riverine flooding by levees.

13.1.5 Management arrangements for levees in rural areas

New urban levee systems to protect existing properties can sometimes be justified on benefit-cost grounds. By contrast, building new, large-scale rural levee systems may no longer be considered best practice because they reduce flood storage, increase flood levels and increase erosion potential within waterways.

Nonetheless, there may be limited circumstances in which new rural levee systems may be contemplated. For example, they might be necessary for environmental watering or to reduce the risk of avulsions. Therefore, the government will not explicitly rule out the construction of new rural levee systems. Any such levee system would need to be fully evaluated through a flood study that took full account of the associated social, cultural, economic and environmental costs and benefits. The government will not fund construction of new rural levee systems, or repair flood damage to existing rural levee systems, that primarily provide private benefits.

An alternative way to reduce existing flood risks in rural areas is to allow landholders to build ring levees to protect individual buildings and curtilages (the enclosed area of land adjacent to a building or dwelling). These are often small enough not to have significant third party or environmental impacts. However, individual levee protection should not be a substitute for setting floor levels above the 1% AEP flood level for new dwellings.

Proposed Policy 13c

- The construction and maintenance of private levees on private land will continue to be regulated through Municipal Planning Schemes.
- Levees on Crown land that are not being formally managed will be allowed to weather away unless those benefiting decide to repair and maintain the levee (or part of the levee) under a permit issued by a CMA (section 13.3).

13.1.6 Essential service providers

Essential services include roads, bridges, dams, weirs, channels, drains, telecommunication facilities, power facilities and water treatment plants. They are owned and operated by a variety of organisations.

The Victorian Government encourages collaboration between essential-service infrastructure providers, local councils and CMAs where new essential-service infrastructure, or the maintenance of existing essential-service infrastructure, has the potential to affect flood behaviour.

The Government also encourages collaboration where new or updated essential-service infrastructure has the potential to provide flood mitigation benefits. This has been achieved at the Western Freeway bypass of Ballarat, for example, where flood-retarding basins have been incorporated into the freeway embankment, reducing the potential for flooding in the Ballarat urban area.

CMAs, councils and essential-service infrastructure providers will be encouraged to collaborate on agreed mitigation options.



Patients were evacuated as flooding made the Numurkah hospital unusable in March 2012. Source – Moira Shire Council

13.2 Bringing existing infrastructure into formal management arrangements

The floods of 2010-11 revealed serious deficiencies in the previous management arrangements for flood mitigation infrastructure outside Melbourne. The Government's response to the ENRC inquiry provides clear policy settings for the ongoing management of Victoria's existing flood mitigation infrastructure.

In practice, this means, for example, that if the existing urban levees outside Melbourne are to be formally managed into the future, they will need to be brought under formal management arrangements. Under these arrangements, they will be owned, managed and maintained by local councils through Water Management Schemes under the Water Act.

13.2.1 Context

It is important to bring this requirement into perspective. Of the levees in Victoria outside Melbourne Water's region:

- About half the urban levees located across a number of municipalities are already being formally managed.
- 3000 km are rural levees on private land and will be privately managed.
- 900 km are rural levees on Crown land and are not currently being maintained. It is likely that most of them will never be formally maintained because the costs of restoring them to a reasonable standard and maintaining them formally will be greater than the benefits. If this is not the case, there will still need to be support from the community and a rating mechanism established by Council to ensure they are maintained.

It has taken many decades to develop the current situation; it will also take time to remedy it. The decisions to be made about which levees are to be formally managed will also take time.

One task for regional floodplain management strategies is to identify and prioritise flood risks in consultation with flood-prone communities. Part of this process will be to understand the standard of unmanaged urban levees as well as rural levees on Crown land. Specifically, there is work to be done in estimating:

- the costs of restoring the levees to a reasonable standard of protection
- the costs of ongoing maintenance
- the benefits of restoring and maintaining the levee.

If the benefiting community, through the local council, judges that their one-third share of the likely capital cost of restoring a large-scale urban levee is affordable, and their ongoing contributions to management and maintenance costs are also affordable, and if the overall benefits outweigh the costs, then it will be worthwhile and necessary to carry out more detailed investigation.

If the benefiting community judges otherwise, the urban levees will not be formally maintained. In the case of rural levees, the decision about whether to invest in the full cost of the upgrade will remain with private beneficiaries.

13.2.2 Formalising the management of existing infrastructure

Councils wanting to bring existing flood mitigation infrastructure into formal management arrangements will require guidance on the process and requirements for sustainable maintenance. Councils will be free to decide whether they want to formalise future management arrangements, in consultation with their local communities. However, if government funding is provided towards the upgrade, it may be conditional on the local council agreeing to manage the infrastructure formally. Preferably, for large-scale infrastructure, this would be implemented through a Water Management Scheme. However, there may be instances (for example in enlarging a road culvert or raising a road) where alternative arrangements are demonstrably more appropriate.

Proposed Action 13b:

The CMAs and Melbourne Water, with support from DEPI, will work in close consultation and collaboration with relevant local councils to develop a process to provide for existing flood mitigation infrastructure to be implemented as Water Management Schemes. That process will:

- begin with an assessment of the condition of the infrastructure and its standard of protection, based on the best available information; in many cases a new flood study may be warranted
- consider options to upgrade the infrastructure to contemporary design standards
- identify, in consultation with the benefiting community, the most cost-effective option that is in keeping with community's willingness and ability to pay for ongoing management and maintenance costs
- establish ongoing management arrangements.

13.2.3 Cost-sharing arrangements

The capital cost of bringing existing infrastructure up to acceptable standards for incorporation into a Water Management Scheme will be shared in the same manner as the capital costs of new infrastructure.

As with new infrastructure, the beneficiaries of existing infrastructure that is to be brought under formal management arrangements to protect urban areas will be required, through their local council, to meet the ongoing costs of management, maintenance and auditing.

The benefits of avoiding disruption to the functioning of urban areas often extend throughout the region's economy. Flood mitigation infrastructure intended primarily to benefit urban areas may also deliver benefits to rural areas. For these reasons, it is appropriate that local council raise the necessary revenue across its municipality.

The Victorian Government will work with local government to determine further guidance on cost sharing arrangements if required.

13.2.4 Opting to leave existing infrastructure unmanaged and unmaintained

At any stage before or during the processes outlined above, it will be open to councils to make conscious decisions not to maintain existing infrastructure. However, if they choose not to, their Planning Schemes and their emergency management plans must take account of the impacts of that decision.

In these circumstances, the Municipal Planning Scheme must, in effect, assume that the infrastructure does not exist. The appropriate zones and overlays should apply to all land within the 1% AEP flood level, regardless of whether it is behind the levee or not. Floor levels for new dwellings should be built above the 1% AEP flood level, including an allowance for freeboard.

In contrast, the Municipal Flood Emergency Plan should assume that the infrastructure does exist and that it is liable to catastrophic failure, unless (subject to a flood study) the infrastructure is formally decommissioned.

Proposed Policy 13d

Where there is unmanaged flood mitigation infrastructure in an urban area:

- the relevant Municipal Planning Scheme must acknowledge that the infrastructure will not provide any flood protection
- the relevant Municipal Flood Emergency Plan must provide for the potential for catastrophic failure of that infrastructure.

13.2.5 Decommissioning flood mitigation infrastructure

On rare occasions, after consultation with their local communities, councils may choose to decommission existing flood mitigation infrastructure.

The process for decommissioning will involve:

- commissioning a study to evaluate impacts
- developing a strategy to manage those impacts in consultation with the local community
- communicating the results of the decision, giving due consideration to the benefits of decommissioning the flood mitigation infrastructure against the costs and disadvantages.

In most situations, it may be more appropriate to leave existing flood mitigation infrastructure unmanaged, particularly if the infrastructure has not been formally maintained for some time.

In some cases, individual landowners may wish to decommission a private levee. This would require a planning permit that enables third party impacts to be considered, and objections to be heard from neighbours.

13.3 Maintaining levees that are not formally managed

While the benefits of a particular levee may not be recognised by a community (and therefore not managed through a formal scheme), there may be individuals who see benefit in that levee and wish to maintain it themselves.

Where the levee is on private land, it will be for the private landowners and any other beneficiaries to negotiate among themselves regarding the ongoing maintenance of the levee. Landholders opting to jointly manage their own scheme may request local council assistance. Local councils should negotiate the terms of assistance directly with the group. DEPI will work with local government to determine how these arrangements could work. There is no role for the state in the management of private levees.

Where the levee is on Crown land, beneficiaries will need approval from the Crown land manager to maintain it. Currently, there are gaps in our legal framework that prevent the beneficiaries of levees on some Crown land types from getting approval to maintain it. Moreover, where there are legal powers to give approval, it can be cumbersome for applicants, especially where the levee crosses multiple types of Crown Land.



A private levee circling this home kept floodwater out. Source: North Central Catchment Management Authority

13.3.1 A permit system for levee maintenance on Crown land

Changes to the Water Act propose a new permit system that will enable the Minister for Water or a delegate such as a CMA to issue individuals with permits to maintain existing levees on Crown land. They will be able to maintain existing levees at their current heights (including scope to restore sunken or eroded sections) and their current lengths, but they will not be able to increase their heights or lengths.

There are about 900 kilometres of existing levees on Crown land. Under the proposed legislation, the beneficiaries of these levees will be able to maintain them, once issued with permits by the Minister for Water or a delegate such as a CMA.

Proposed Policy 13e

- The beneficiaries of levees on Crown land that are not formally managed will be able to maintain the height and length of those levees subject to a permitting system administered by the CMAs and Melbourne Water.
- Permits to maintain levees on Crown land will be subject to conditions specified by both the Crown land manager and the Minister for Water or a delegate such as a CMA.

Proposed Action 13c:

- DEPI will prepare guidelines on how to apply for permits to maintain levees on Crown land.
- CMAs will make these guidelines available at their offices and on their websites.

It is also proposed that a person holding a levee maintenance permit will not require a permit under the relevant Municipal Planning Scheme. Nonetheless, their maintenance activities will have to comply with legal obligations that protect Aboriginal, cultural heritage and environmental values.

13.3.2 Respecting Aboriginal and cultural heritage

Aboriginal places and objects in Victoria, whether known or unknown, are protected under the *Aboriginal Heritage Act 2006* and cannot be disturbed or destroyed without authorisation. Cultural Heritage Management Plans are required for proposed high-impact activities in listed areas of cultural heritage sensitivity, as defined in the *Aboriginal Heritage Regulations 2007*. Cultural Heritage Management Plans are a way to protect and manage cultural heritage, while allowing for some development.

Applicants for levee maintenance permits will need to provide evidence of compliance with the requirements of the relevant Aboriginal cultural heritage authorities to avoid or minimise the impacts on any relevant sites or objects.

Proposed Policy 13f

- Applicants for levee maintenance permits will need to provide evidence of their compliance with Aboriginal cultural heritage requirements before their applications can be lodged.

Proposed Action 13d:

- DEPI's guidelines on how to apply for permits to maintain levees on Crown land will include practical advice on how applicants for these permits can seek to meet their obligations to protect Aboriginal cultural heritage.

13.3.3 Respecting environmental values

Floodplains are valuable places, not only for farms, communities and native title holders, but also for the environment. It is important that when we act to protect farms and communities from flood risk, we do not diminish the environmental values. It is also important to take into account the benefits to the environment that flooding provides.

At the moment, Victoria protects environmental values through a number of Acts of Parliament. Each of these acts protects environmental values through different approval processes. The segmentation of these approvals can place individuals in a position where they are hesitant about taking action to protect themselves against flood risk.

For this reason, DEPI is working to streamline environmental approvals in relation to floodplain management.

Proposed Action 13e:

- DEPI's guidelines on how to apply for permits to maintain levees on Crown land will include practical advice on how the applicants for these permits can meet their obligations to protect environmental values.

13.4 Cross-border issues

The 2010-11 floods brought into focus long-standing issues about the lack of cross-border integration in the design and management of flood mitigation infrastructure. Communities along the Murray River expressed concerns that levees on one side of the river had aggravated flood impacts on the other side. They were also concerned that not enough had been done to take advantage of opportunities for each state to share floodwaters, and flood storage capacity, through the integrated operation of regulators.

Cross-border issues are complex. Levees are located along various parts of the Murray River in both New South Wales and Victoria. They are built to different standards and under different regulatory frameworks. There is also a mix of public and private infrastructure managers and their operational rules, in some cases, are not formalised.

The Victorian Government has asked DEPI to work with its NSW counterparts (through the NSW Cross-Border Commissioner) and the Murray-Darling Basin Authority to identify what can be done to ensure that authorities on both sides of the border work cooperatively to manage flood impacts.

In meeting this commitment, some basic rules will need to be established around managing existing and new infrastructure:

- The existing regulatory instruments and interstate referrals processes should be strengthened to enable flood impacts to be managed responsibly and consistently on both sides of the border.
- It is difficult to remove existing rights to manage levees established under previous management regimes. However in principle there should be no increase in the height or length of existing levees without triggering a cross-border referral.
- Formal cross-border referral processes and principles for decision making need to be strengthened. Both sides should have an opportunity to examine infrastructure proposals and their impacts, and decision makers should communicate to the other side how their views have been taken into account. Managing the impacts of levees often transcends municipal boundaries.

- It should be up to the proponent to determine what impacts there are on third parties on either side of the border, it should also be up to them to provide the evidence, and to demonstrate how impacts on third parties are to be addressed.
- Operation procedures for large-scale regulators should be documented and included in emergency response plans. Their operation should be reviewed and, where mutually beneficial, altered to reduce flood risk.

In general, cross-border issues can be resolved at the local level once states have established a formal commitment to work together. Ideally, for example, NSW agencies should actively participate in Victoria's Regional Floodplain Management Strategies so that any NSW issues can be considered, and opportunities to seek resolution identified and implemented.

Similarly, the operational rules for regulators should be incorporated into emergency management plans on both sides of the border. This would provide communities and emergency management agencies with certainty about the management of those regulators during floods.

Proposed Policy 13g

- Victoria will take a no borders approach to floodplain management on the Murray River:
 - All proposals for large-scale flood mitigation activities on the Victorian side of the river will be referred to appropriate NSW agencies for advice.
 - Relevant NSW agencies will be encouraged to actively participate in the development of relevant regional floodplain management strategies.

Proposed Action 13f:

- DEPI will approach the NSW Government with a view to establishing formal arrangements for the construction and management of new flood mitigation infrastructure.
- DEPI will require that Regional Floodplain Management Strategies take into account cross-border issues and actively seek participation from NSW counterparts.
- Municipal Emergency Response Plans will include cross-border issues.

Chapter 14: Flood mitigation activities on waterways

The Victorian Waterway Management Strategy (VWMS) 2013 provides the framework for maintaining and improving the condition of Victoria's rivers, estuaries and wetlands. It aims to ensure that waterways continue to support environmental, social, cultural and economic values for all Victorians. Flood mitigation activities on waterways (such as vegetation clearance, debris removal and sediment removal) must be carried out in ways that are consistent with the VWMS.

The CMAs and Melbourne Water (MW) have statutory responsibilities for waterway health and waterway management. Their regional waterway strategies outline regional goals for waterway management. They also result in works programs developed in consultation with local communities.

Proposed Policy 14a

- Regional floodplain management strategies must be aligned, as closely as practicable, with the policies and objectives of relevant regional waterway management strategies.

The CMAs and MW also have a regulatory role, under the *Water Act 1989*, in authorising individuals and organisations to carry out flood mitigation activities on waterways. However, they do not have a responsibility to carry out flood mitigation activities on waterways. If the beneficiaries are willing to cover these ongoing costs, MW and the CMAs will help enable those activities in accordance with state and regional waterway management strategies.

MW and the CMAs are responsible for large-scale works to manage waterway erosion and works or advice to minimise the risk of avulsions. They are also responsible for setting regional priorities in the planning, construction and restoration of flood mitigation activities on waterways.

Accountability 14a:

- Melbourne Water and the CMAs are accountable, on a priority basis, for works to manage large-scale waterway erosion.
- Melbourne Water and the CMAs are accountable for implementing works or providing advice to minimise identified risks of avulsions.

14.1 An authorisation framework for flood mitigation activities on waterways

The Victorian Government is putting in place a framework for authorisation of flood mitigation activities to enable individuals, infrastructure managers, councils and other authorities to carry out flood mitigation activities on waterways. The framework will deal with large-scale flood mitigation projects, that typically benefit urban communities, as well as small-scale activities that may benefit individual landholders.



In stream debris after 2011 flood at Hepburn Regional Park. Source: DEPI.

14.1.1 Authorisation for larger-scale activities for urban areas

For larger-scale flood mitigation activities on waterways, say for sediment or vegetation removal activities intended to reduce flood risks at the township scale, a flood study will be required before authorisation is granted.

If a flood study demonstrates that flood risks can be materially reduced by flood mitigation activities on waterways, it is likely that they will need to be carried out regularly. It is rare for these activities to be one-off jobs; vegetation regrows and sediments are always being deposited in streams.

It is important for the beneficiaries to consider whether they are willing and able to meet those ongoing costs.

Councils wishing to carry out flood mitigation activities with demonstrated benefits will be able to apply to the relevant CMA or MW for authorisation to do so. Authorisation will be subject to conditions designed to ensure that the costs to waterway health, if any, are commensurate with the demonstrated flood mitigation benefits. Authorisation will include a requirement to complete activities within a defined timeframe – typically 12 months.

An alternative open to councils wishing to secure approvals for longer term ongoing activities would be to apply to implement them as Water Management Schemes under the Water Act. The processes involved in establishing a Water Management Scheme are described in section 13.1.1.

Proposed Policy 14b

- Where flood studies demonstrate that flood risks can be materially reduced by large-scale flood mitigation activities on waterways, individuals or councils will be able to carry out those activities subject to authorisation granted by the CMAs and Melbourne Water.
- If a waterway is to be modified or if vegetation, debris or sediment is to be removed from a waterway for flood mitigation purposes, and these activities are to be implemented as Water Management Schemes, the relevant council or other authority responsible for implementing the scheme will be responsible for undertaking the work (in compliance with any relevant conditions) and for all ongoing maintenance.
- Large-scale flood mitigation activities on waterways must be demonstrated, through a flood study, to be cost effective, that is, have demonstrable benefits in terms of reduced average annual damage (AAD) and those benefits must be greater than any costs to waterway health.

Proposed Action 14a:

- DEPI will prepare guidelines on how to apply to a CMA or Melbourne Water for authorisation to carry out large scale flood mitigation activities on waterways. These guidelines will include practical advice on how to meet Aboriginal and cultural heritage protection requirements. They will also include practical advice on how to meet environmental protection requirements, and have regard to benefits for rural drainage.
- CMAs and Melbourne Water will make these guidelines available at their offices and on their websites.

14.2 Authorisation for small-scale activities

Where individuals, groups of landholders, infrastructure managers, councils or other authorities propose small-scale activities to remove vegetation or flood debris, CMAs will use risk assessment guidelines prepared by DEPI to help them determine whether these activities can be authorised without the need for a flood study.

Proposed Policy 14c

- Individuals or groups of landholders, infrastructure managers, councils or other authorities proposing small-scale activities to remove vegetation, remove sediment or remove or realign debris from a waterway must obtain authorisation from the relevant CMA or Melbourne Water.
- When determining whether to grant authorisation for proposed activities, the relevant CMA or Melbourne Water will consider potential risks to waterway health. The CMA or Melbourne Water may require the proponent to undertake alternative activities to minimise any risks.

Proposed Action 14b:

- DEPI will prepare guidelines to enable landholders, asset managers the CMAs and Melbourne Water to determine when proposals for vegetation and flood debris removal can proceed in the absence of a flood study, based on an appraisal of risk. The guidelines will take into account the benefits for floodplain management, rural drainage and waterway management.
- CMAs and Melbourne Water will make these guidelines available at their offices and on their websites.

14.3 Linkage with the rural drainage strategy

DEPI will be preparing a rural drainage strategy that will provide strategic guidance for matters relating to rural drainage. This will include consideration of clearing a stream of debris or sediment that may have multiple benefits (e.g. flood mitigation, rural drainage and waterway management) and involve the same activities and potential costs.

Chapter 15: Reforming stormwater management in Melbourne and regional cities and towns

Urban flooding is a major existing and potential future issue for suburban Melbourne and urban areas across regional Victoria. Urban flooding has the potential to result in significant human, economic and financial costs. In 2009, Melbourne's total annual flood risk was estimated to be in excess of \$260 million.²

Three main types of floods affect Victoria's cities and towns:

- Riverine flooding arises when rivers and creeks breach their banks and flow onto the surrounding floodplain.
- Urban stormwater flooding is caused by stormwater runoff from severe storms in urban areas with high degrees of imperviousness. Underground drainage systems fill to capacity and flood waters are forced move along overland flow paths.
- Coastal tidal and storm surge flooding, caused by extreme weather conditions and/or abnormal ocean tides, leads to flooding of the coastline and nearby tidal rivers.

Measures to manage the risks associated with riverine and coastal inundation and extreme flood risks are addressed in detail in other chapters. This section focusses specifically on urban stormwater flooding.

In Melbourne, more than 100,000 properties are known to be at risk from flooding from the rivers, creeks and drains that are the responsibility of Melbourne Water Corporation. A considerable but unquantified proportion of Melbourne's households are at risk from urban stormwater flooding from local government catchment drains (Melbourne Water 2007). Of the properties known to be at risk, 80 per cent are potentially threatened by flooding from the drainage system.

These problems have generally arisen from pre-1970 urban development that did not adequately provide clear overland flow paths. Floods often happen with little warning and many of those affected lack awareness of flood risk.

15.1 Urban stormwater flooding

Urban stormwater flooding is directly related to increases in the volume and intensity of stormwater runoff from impervious surfaces created by urban development. This flooding is often smaller in scale than riverine flooding, but can cause substantial property and infrastructure damage, and disruption to local communities.

Urban stormwater flooding may be further exacerbated by climate change and uncertainty, with the likelihood of increased summer convectional storms.

Urban stormwater flooding occurs in areas:

- developed before modern engineering drainage standards were introduced across Australia in the 1970s that allowed for overland flow along former valley lines in the urban landscape
- developed before appropriate planning controls were introduced to help manage exposure to flood risk
- affected by progressive infill development and development within upstream catchment areas without adequate stormwater retardation or retention.

The objectives of urban drainage are no longer exclusively flood protection. The increased stormwater runoff resulting from development (even after relatively small rainfall events) has a detrimental impact on the environmental health of the waterways, disturbing the natural ecology and changing channel formations. Stormwater management is also important in social amenity and pollution control.

Effective management of urban stormwater flooding requires a detailed understanding of the urban water cycle and the application of whole-of-water-cycle management (WWCM). This includes identifying and prioritising areas most at risk, exploring community expectations for flood management, and developing cost-effective and efficient solutions that deliver multiple benefits. These benefits include reductions in system costs, drinking-quality water use, energy use and stormwater runoff, as well as improvements in liveability and environmental outcomes.

The solutions will be developed by careful analysis and planning, based on improved data and a clearer understanding of interactions within the water cycle. This will include analysis of changes in rainfall patterns, rainfall intensity and peak flows and volumes.

Options to mitigate stormwater runoff could include:

- improving urban and building design
- investing in stormwater harvesting and retention in the upper catchment
- improving infrastructure (including new approaches to managing stormwater peaks)
- educating stakeholders about managing their response to flooding risk.

² Halcrow Pacific for DSE Flood Risk Reduction-Assessment of Costs and Benefits August 2009.

15.2 Urban water reform agenda

The Government's urban water reform agenda requires a holistic approach to the management of water in Victorian towns and cities that focuses on understanding the system and the interconnections between its components. This approach considers all forms of water, including rainwater, stormwater, recycled wastewater and groundwater and how the design of our urban centres can be optimised to make best use of these sources of water while delivering a range of social, environmental and economic benefits.

Whole-of-water-cycle management (WWCM) seeks to bring together a range of partners, from local government to water corporations, catchment and developers to help design Victoria's towns and cities with water in mind. In considering the future impacts of climate change, population growth, and urbanisation, WWCM demands future-oriented

planning that has considerable potential to improve the management of stormwater, ensure urban flooding is no worse as a result of new development, while delivering improved urban amenity outcomes. As shown in Figure 8, this rapidly developing area of reform intersects with broader approaches to floodplain management and, as work progresses, will further complement efforts to improve the management of floods in Victoria.

Initial work on this urban water reform agenda has delivered Melbourne's Water Future, a strategy to help Melbourne to become more self-sufficient in its use of water. Work is also progressing on Living Ballarat project, which is demonstrating how alternative water sources can be used locally to keep regional cities green, liveable and prosperous. The Office of Living Victoria (OLV) is leading implementation of the government's urban water reform agenda.



Warrnambool stormwater project. Source: Wannon Water.

Figure 8: The interface between the Draft Victorian Floodplain Management Strategy and Whole-of-Water-Cycle Management



Note: Factors that may contribute to extreme risk: • Significant threat to life, health & safety • Potential impacts to large numbers of people • Significant environmental impacts • Significant disruption to economic activity or public infrastructure

Melbourne's Water Future identifies two key approaches for delivering affordable water services:

- increased transparency about water sector costs and performance
- better allocation of water sector investment.

The decision rule to be used for water cycle investments is a calculation of the net benefits of an WWCM opportunity compared to a 'business as usual' scenario for providing water cycle services to a given area. This approach will assist holistic investigation of flooding and stormwater benefits alongside other water cycle requirements (water supply, wastewater management, environmental health and urban amenity).

The cumulative effect of stormwater management initiatives outlined in Melbourne's Water Future will help reduce the risk of flooding in urban areas. In particular, rainwater and stormwater harvesting (including real time responses to forecast storm events) and a reduction in the connection of hard services to drainage systems will slow the transfer of stormwater flows into streams in some rainfall events.^{3,4,5,6}

Similarly, soil moisture retention strategies such as rain gardens and the similar, but much larger, evapotranspiration beds as well as tree plantings and wetlands will contribute to a reduction in peak flows.

WWCM recognises the importance of integrating water cycle and land use planning. It is important that new greenfield development, infill development and urban renewal areas are designed to mitigate property damage and other impacts associated with flooding. New developments must be planned and constructed to ensure they do not cause downstream flooding and avoid increases in the associated infrastructure or maintenance costs of managing flooding.

Systems analysis developed for the Living Victoria Ministerial Advisory Council identified that applying a WWCM approach will achieve whole-of-system cost savings over a 40-year outlook. These include savings from deferral of planned augmentations of the existing system. Careful monitoring and analysis will be required to fully understand the opportunities for delivering system cost savings.

A WWCM approach will provide the most appropriate stormwater management solutions at household, precinct, local, sub-regional and metropolitan scales, and better reflect local conditions and needs. This approach will be extended progressively to all urban areas across Victoria, using local community engagement to help decide how a WWCM approach can be used most effectively in each location.

Improvements in the management of stormwater in existing urban and greenfield areas will be supported by:

- proposed modifications to the planning system and building regulations designed to better manage stormwater flows at the building lot scale through urban catchments
- improved drainage network and flood risk knowledge, information and maintenance
- progressive development of place-based local and sub-regional WWCM plans that identify the most efficient and effective solutions at the most appropriate scale
- mapping of properties and infrastructure at risk of flooding
- review of flood control design responses for new subdivisions in light of the new standards under development
- trialling new flood prevention measures in established suburbs during the maintenance and replacement of stormwater drainage (this might include the management of rainwater tanks and landscape features such as artificial lakes to provide a component of flood mitigation)
- leveraged investment in projects that provide multiple benefits to the community
- monitoring of outcomes and measurement of the cumulative effect of all proposed initiatives together with social and economic costs associated with urban flooding
- trialling market-based approaches to encourage efficient investment in stormwater runoff reduction.

These measures will be considered in the development of Melbourne Water Corporation's regional floodplain management strategy.

The experiences gained in the preparation of regional floodplain strategies and working with local government will be shared by Melbourne Water Corporation and the Catchment Management Authorities. This will help the assessment of intolerable stormwater flood risks and impacts by local government.

Where an area of intolerable stormwater flooding within a regional city has been identified in the regional floodplain management strategy, local councils will engage with their local communities and evaluate treatment options to reduce risk.

- 3 Rainwater tanks were accepted as a means of flood mitigation in the Maroondah City Council VCAT Hearing, Sept 2006, VCAT Ref no P1382/2006.
- 4 GHD for Melbourne Water, Report for Oakleigh North Drain RSS Pilot Study, July 2011.
- 5 P Coombes for Knox City Council, The Use of Rainwater Tanks as a Supplement or replacement for On-site Detention, 2008.
- 6 Watertechnology for Melbourne Water and City of Glen Eira, Integrated Water Management Opportunities for Glen Eira, September 2013.

Table 15.1: Recommended actions in *Melbourne's Water Future* relating to flooding

Reference	Action
3.2.5	Provide consistency and links between water management provisions in the planning system with those under consideration for inclusion in the building controls to enable WWCM outcomes to be achieved at the scale most appropriate to each location (lot-precinct-growth corridor).
3.2.6	Map the priorities and infrastructure at risk of flash flooding from local drainage systems and riverine flooding as part of the regional and local water cycle planning.
3.2.6	Continue working with relevant agencies at all levels of government to map properties and infrastructure at risk from coastal tidal and storm surge flooding.
3.2.6	Review flood control design responses for new subdivisions in light of the new standards under development.
3.2.6	Trial new flood prevention measures in established suburbs during stormwater drainage maintenance and replacement.
3.2.6	Measure the cumulative effect of these initiatives together with the social and economic cost associated with flooding, including the cost of insurance premiums. This research will form an important input into the business cases for the whole-of-water cycle management approach.

Importantly, WWCM planning at broader sub-regional and regional scales can help identify the interventions and investments that may, for example, be more effective in the upper catchment than in flood-prone areas in the lower catchment.

Proposed Policy 15a:

- Land use and water cycle planning will be integrated to deliver WWCM outcomes, including reductions in stormwater runoff to cost-effectively assist mitigation risks and impacts of urban flooding in Melbourne and regional cities and towns.
- At the project level, measures to manage flood risks associated with stormwater in urban areas will include an evaluation of all potentially effective flood mitigation techniques and consideration of solutions that advance WWCM and delivery benefits including liveability and resilience.
- There will be increased scrutiny of major investment decisions related to stormwater management, including whole-of-society and whole-of-system costs and opportunity for system cost savings through the adoption of WWCM approach.

Proposed Actions 15a:

- Office of Living Victoria will:
 - continue to deliver WWCM policy and guidance to support cost-effective investment that reduces flood impacts and provides associated benefit, such as improved environmental outcomes and liveability.
 - support and facilitate WWCM planning and projects at sub-regional and local levels ensuring that the mitigation of urban stormwater flooding is considered in co-operation with water corporations and floodplain managers (OLV has commenced plans for three sub-regional WWCM plans for Melbourne — West, North and Inner)
 - finalise draft guidelines for local WWCM planning and support the development of local WWCM plans commencing 2014/15
 - oversee implementation of the government's commitments set out in *Melbourne's Water Future* (see table 15.1)
 - trial market-based approaches as a mechanism to encourage efficient investment in stormwater runoff reductions.

Proposed Actions 15a continued:

- Melbourne Water will:
 - work closely with relevant stakeholders to assist in identifying flood risks through improved mapping of local scale flood risks
 - evaluate mitigation options within a WWCM planning framework.
 - engage with the community on cost-effective approaches to managing flood risk within a WWCM planning framework that includes both investment decisions and behavioural change
 - identify areas of intolerable riverine flooding in Melbourne in the development of Melbourne Water's Regional Floodplain Management Strategy.
- CMAs will:
 - identify areas of intolerable riverine flooding in regional cities in the development of Regional Floodplain Management Strategies
 - work with local government to align and integrate management strategies with water cycle and land use planning at the appropriate geographic scale.
- Local Councils will:
 - in Melbourne, work with Melbourne Water and other stakeholders to confirm areas subject to intolerable stormwater flooding and the most cost-effective responses within WWCM planning at subregional and local scales
 - identify areas of intolerable urban stormwater flooding in regional cities and towns and evaluate treatment options within a WWCM planning framework
 - engage with the community on cost-effective approaches to managing flood risk within a WWCM planning framework that includes policy, planning changes investment decisions and behavioural change.

Section 4

Managing Residual Risks



Cardross Flood. Source: Mallee Catchment Management Authority.

Chapter 16: Business continuity plans for critical infrastructure

Some infrastructure is critical to the health, safety and prosperity of the Victorian community. The Victorian Critical Infrastructure Resilience Interim Strategy (VCIRIS) outlines how the Victorian Government will take appropriate measures to ensure that the owners and operators of critical infrastructure are managing their risks and that vital service delivery is not interrupted.

The VCIRIS and associated legislation will put in place risk management processes designed to ensure continuity of supply for services essential to the community.

The operators of critical infrastructure will be responsible for developing and implementing site-specific strategies to mitigate the affects of natural hazards (including flooding) to ensure the continuity of essential services.

The proposed legislation will require owners and operators of infrastructure deemed to be 'vital' critical infrastructure to participate in mandatory risk management activities to build their resilience to all hazards. The legislation is designed to optimise the risk management practices undertaken by owners and operators of 'vital' critical infrastructure; it will create a flexible assurance framework.

In developing appropriate flood mitigation strategies, the operators of critical infrastructure deemed vital may need to undertake a flood risk assessment. DEPI will make available in any relevant flood-related material for this assessment.



Levees protect critical infrastructure in Culgoa floods.
Source: Mallee Catchment Management Authority.

Accountability 16a:

The operators of essential service infrastructure are each accountable for:

- assessing the risks posed to their operations by flooding
- developing and implementing fit-for-purpose flood risk mitigation plans for each facility at risk of flooding
- developing fit-for-purpose flood response plans.

It is possible that some critical infrastructure, despite being covered by adequate flood risk mitigation plans in the short to medium term, is nonetheless at long-term risk from waterway processes. For example, it may be that the functioning of a bridge or weir is at identified risk from a river avulsion due to natural flood-related processes. In these cases, Melbourne Water and the CMAs can provide relevant information to enable the infrastructure operator to help develop longer-term risk management strategies.

Accountability 16b:

- Melbourne Water and the CMAs are accountable for monitoring the condition of waterways to assess the risks of large-scale erosion and avulsions.

Proposed Action 16a:

- DEPI will, in consultation with waterway managers, floodplain managers and representative asset owners develop principles for managing serious risks to public infrastructure from waterway processes (see Action 4.2 in Victorian Waterway Management Strategy) in accordance with the principles and obligations outlined in the Victorian Critical Infrastructure Resilience Interim Strategy and associated legislation, where relevant.

Chapter 17: Flood insurance

The terms of reference for the 2011 National Disaster Insurance Review (NDIR) neatly summarise the role of insurance in helping to manage flood risk. Importantly, they also summarise why government has a role in fostering the establishment and development of an appropriate flood insurance regime for Australia.

According to those terms of reference, at the most fundamental level, governments have a role in ensuring that:

- individuals and communities affected by floods are able to recover and rebuild as quickly as possible
- people are able to choose where they live in an informed way (the inference being that the relative size of flood insurance premiums in different locations provides an important signal)
- individuals and communities at risk of future flooding are aware of the risks and are able to obtain suitable protection against those risks, both in terms of having access to insurance and in benefiting from appropriate mitigation strategies.

The Commonwealth Government, in response to NDIR's 47 recommendations:

- introduced a standard definition of flood for inclusion in all insurance policies offering flood cover
- committed to the introduction of a national portal to improve the coordination, and the public availability, of flood risk information
- undertook to consult with relevant stakeholders on other recommendations.

The Insurance Council of Australia (ICA), which represents more than 90% of the total premium income written by private sector general insurers, released a 10-point plan aimed at developing a more effective and sustainable response to disasters in Australia.

The ICA believes that government has three key roles in supporting flood insurance:

- ensure the availability of high-quality information about flood risk [section 8]
- mitigate the legacy of existing flooding exposure [sections 13.1 and 13.2]
- prevent the flood-prone population expanding [sections 10.2.3 and 10.2.5].

These three roles have each long been seen as core business for government. Nonetheless, the NDIR, the ENRC inquiry into flood mitigation infrastructure and the VFR revealed considerable scope for improvement in how each of those roles was being fulfilled prior to the 2010-11 floods.

This strategy addresses those necessary improvements.

Of those three roles, it seems likely that there is particular scope for improving the availability of, and access to, high-quality information about flood risk. Partly this is a result of the ongoing revolution in information management, but partly it is a consequence of the relative infancy of the flood insurance industry in Australia.

Proposed Policy 17a

- DEPI will work with the insurance industry to share flood data in an efficient and practical manner.

Proposed Action 17a:

- DEPI will provide the insurance industry with access to:
 - all digital elevation data held by DEPI
 - all flood mapping held by DEPI.
- DEPI will seek ongoing access to the National Flood Information Database, used by most insurers as a core input to assessing flood risk at the address level across Victoria.
- DEPI will work with the insurance industry to ensure insurance premiums consider the benefits if flood mitigation works that are formally managed and flood risk profiles based on a range of floods (and the associated probabilities).

Chapter 18: Disclosing flood risk information

As outlined section 10.1, land-use planning provisions do not apply to land subject to inundation by floods less likely than the 1% AEP flood. When they do occur, floods larger than a 1% AEP will cause significant damage and considerable cost. Therefore it is still important for people living and working in those flood-prone areas to be able to make informed decisions about risk management. It is also important to ensure that essential infrastructure, such as roads, telecommunications and gas lines are sited in locations commensurate with the flood risk.

In many places, flooding in 2010-11 extended well beyond the 1% AEP flood. Emergency services need to be able to plan with their communities for such flooding. They also need to be able to issue accurate and timely warnings.

This flood information needs to be provided in a manner that does not unnecessarily alarm communities, particularly where flooding beyond the 1% AEP flood may cause short-term inconvenience or nuisance rather than a risk to property, livestock or safety.

18.1 Comprehensive flood mapping

As detailed in section 8.2, the Victorian Flood Database contains several layers of modelled flood extents for a range of floods from moderate to extreme. The starting point for disclosing flood risk information is to make sure that these maps are in the public domain and readily accessible. Accurately priced risks

Individuals armed with high-quality information about their exposure to flood risks ought to be in a position to negotiate insurance premiums that reflect that risk. They can now seek this information from CMAs.

In an ideal world, insurance premiums would vary with the mapped range of flood probabilities from moderate to extreme. Insurers would, however, have to take account of the less certain risk of flooding associated with urban drainage systems on top of the better-understood risks of riverine flooding.

Proposed Policy 18a

- To encourage property owners to take an active interest in ensuring that their insurance premiums are tailored to their flood risks, DEPI will seek to ensure that individuals can have full disclosure of the flood risks associated with their property, not just information relating to the 1% AEP flood.

18.2 Vendor disclosure statements

One of the guiding principles underpinning this strategy is that people living on floodplains should be able to make informed choices about the risks they face. Similarly, people considering whether to buy properties on floodplains should be informed about flood risks before deciding to buy.

As outlined, in sections 18.1, making this information more accessible is key to people being able to make informed choices about managing their own risks. It is also key to ensuring economic efficiency in the insurance market and the land market.

In a world where flood risks are mapped, those risks should be priced into land values. Developers in these situations should be able to identify the full costs of their proposals, including costs in the form of average annual damage (AAD). By contrast, where flood risks are not mapped, those risks are unlikely to be priced into land values because the flood risks (and potential development constraints) are not recognised.

The dilemma for governments is that once flood risks are mapped, if those risks are not adequately communicated then, in economic terms, they make for information asymmetry. That is, people selling land on floodplains may have more information than potential buyers. This distorts land markets.

One way to avoid distorting the land market would be to include the probability of flooding on the vendor statements required by the *Sale of Land Act 1962*. At their most fundamental level, these statements are intended to ensure the disclosure of information that may have a bearing on the decision to buy the property or the price to be offered. Bush fire risks are now disclosed on these statements.

Planning controls in the form of zones or overlays must also be disclosed. People buying land in those municipalities that incorporate flood provisions into their local Planning Schemes already receive this information on disclosure statements. Assuming that all relevant Planning Schemes will eventually include appropriate flood zones and overlays, including the probability of flooding on the vendor statement would be aimed at people buying properties outside the 1% AEP flood level.

Proposed Action 18a:

- DEPI will work with DTPLI and Consumer Affairs Victoria to ensure flood risk information is included on vendor disclosure statements in the future.

Chapter 19: Integrated flood emergency management

One of the key objectives of emergency management (as set out in Section 5 of the *Emergency Management Act 2013*: Objectives of Act) is a system that “*minimises the likelihood, effect and consequences of emergencies*”.

In Victoria, emergency management has been structured around three separate but interdependent components:

- **Prevention:** reducing or eliminating the incidence or severity of emergencies and mitigating their effects.
- **Response:** combating emergencies and providing rescue and immediate relief services.
- **Recovery:** assisting people and communities affected by emergencies to achieve a proper and effective level of functioning.

Statewide accountability for these three components needs to be assigned and tailored for particular hazards and organisations. When it comes to floods, DEPI, Melbourne Water and the CMAs have primary responsibility to work with local councils and SES on prevention activities. SES has primary responsibility for response activities. The Department of Human Services (DHS) has primary responsibility for coordinating recovery activities.

SES is responsible for the community education and awareness that underpins flood preparedness. This includes its Flood Safe Program. Acting in support of Municipal Emergency Management Planning Committees, SES and local councils are jointly responsible for preparing Municipal Flood Emergency Plans.

It should be noted that the PRR approach (prevention, response and recovery) used in Victoria is a variation of the PPRR approach (prevention, preparedness, response and recovery) to emergency management used in some other jurisdictions.

Accountability 19a:

- SES is accountable for leading the development of Flood Emergency Planning. This includes the development of a State Flood Emergency Plan, Regional Flood Emergency Plans and Municipal Flood Emergency Plans.

Emergency service agencies need to understand, and be informed by, the flood mitigation measures in place. Similarly, those flood mitigation measures should be designed and implemented in the expectation that emergency management access, egress and evacuation may be needed.

Floodplain management services must seek to address the needs of other agencies. For example, DEPI is responsible for flood mapping but the maps it prepares must be designed to meet a range of business requirements within and outside the department. Those maps must be designed to:

- underpin land use planning
- identify high flood risk areas for targeted mitigation works
- underpin emergency warnings by SES
- underpin emergency management arrangements by SES and local councils
- indicate to DHS, after the event, priority areas for recovery efforts.

In the context of Municipal Flood Emergency Plans, the services provided by Melbourne Water and the CMAs should be tailored towards the completion of SES’s template for Municipal Flood Emergency Plans. Specifically, their flood study outputs should aim to describe:

- flood threats (Appendix A of the template)
- typical flood peak travel times (Template Appendix B)
- an overview of flooding consequences (Template Appendix C)
- an overview of existing flood mitigation infrastructure (Template Appendix C)
- an overview of flood impacts and required actions (Template Appendix C)
- flood warning systems (Template Appendix E)
- maps (Template Appendix F).

The institutional challenge is to make sure that all these things are ‘joined up’. We need to be able to provide assurance that all emergency management functions are integrated.

Accountability 19b:

- Melbourne Water and the CMAs are accountable for making sure that the outputs of their activities can be integrated with other emergency management functions.

When a levee is overtopped, there is a chance that it could fail catastrophically. Emergency management plans need to make provision for evacuation in advance of that happening.

Proposed Action 19a:

- SES will determine how best to deal with the issue of levee overtopping or failure as part of its Municipal Flood Emergency Plans.
- DEPI, CMAs and Melbourne Water will provide technical advice to assist SES in its planning around levee failure.

Chapter 20: Incident control

During flood incidents, DEPI, the CMAs and Melbourne Water (MW) will provide SES with advice and support, in accordance with the Emergency Management Manual Victoria.

The roles of the CMAs and DEPI are interdependent. In broad terms, DEPI relies on the CMAs for detailed advice about specific incidents; the CMAs rely on DEPI for strategic advice and assistance.

Flood response activities in Victoria are managed using the Australasian Interservice Incident Management System (AIIMS). This requires the relevant control agency (in the case of floods, SES) to develop an Incident Action Plan for every flood.

As part of that action plan, the Incident Controller establishes an Incident Management Team. Such teams generally include DEPI (at the state level) or the CMA (at the regional level) to provide flood interpretive services.

Accountability 20a:

- SES, with support from DEPI, is accountable for determining the necessary qualifications and competencies required to provide flood-specialist services to Incident Controllers during floods.
- DEPI, Melbourne Water, the CMAs and water corporations are accountable for maintaining the expertise to provide flood-specialist services to Incident Controllers during floods.
- SES is accountable for ensuring arrangements are in place to access flood-specialist services during floods.

Under section 43 of the State Emergency Services Act: “Any damage to property caused by a Service [e.g. SES] member or a volunteer emergency worker during an emergency in the exercise of any power or the performance of any duty conferred or imposed by or under this Act is deemed to be damage caused by the emergency which gave rise to the involvement of the Service within the meaning of any policy of insurance covering the property so damaged notwithstanding any clause or condition to the contrary in the policy.”

There are also provisions in that Act to protect SES employees and directors from liability for actions taken in good faith in the performance of their functions and duties.

SES may call on DEPI, CMAs MW and other water corporations to provide surge capacity, under the direction of the Incident Controller, to help manage the flood response. For example, acting in that capacity, MW and the CMAs may be asked to help clear debris built-up against structures in waterways during or immediately after a flood, provided the working conditions are safe.

Similarly, SES may call up support agencies to build temporary levees, or modify or breach existing levees, at the direct request of the Incident Controller, subject to safety considerations. Such actions hold the potential to adversely affect individuals, even though they are intended to increase the overall public good.

If necessary, the State is willing to assume vicarious liability for the consequences of such decisions made during an emergency, provided the decisions are made by Incident Controllers in consultation with Emergency Management Teams that include MW or the CMAs and Victoria Police.

Proposed Policy 20a

- Temporary levees, waterway diversions or alterations to existing flood mitigation infrastructure will only be undertaken during floods under the direction of Incident Controllers.

Proposed Action 20a:

- DEPI will work with SES to develop decision-making guidelines for building or breaching levees during a flood incident.
- DEPI will work with SES to develop a process to enable the evaluation and authorisation of emergency works for flood response.

A large part of flood response and recovery cost relates to impacts from high-energy flows in rivers and streams. They include accumulation of flood debris, erosion of the bed and banks, siltation and avulsions. Often, fences protecting riparian vegetation may also be lost or damaged.

MW and the CMAs may provide surge capacity to the Incident Controller during flood events to help deal with these issues. Ultimately though, asset owners are accountable for the functioning of their assets (section 16). For example, if debris builds up against a bridge or culvert, or behind a dam, the manager of the asset is expected to remove the debris.

Emergency management agencies will need to work with Aboriginal people to help ensure Victoria’s emergency management arrangements take into account the risks to Aboriginal cultural heritage. The State control priorities for fire (which form the basis of the Incident Strategy and Incident Action Planning processes) already include the protection of environmental and conservation assets and makes explicit reference to their cultural values.

Chapter 21: Managing residual water

Water remaining in the landscape after flood peaks have passed can pose risks to human health, community wellbeing and the functioning of regional economies. Consequently, emergency managers sometimes need to take steps to manage this residual floodwater.

The response component of the emergency management system is focused on managing the impacts of the flood peak. Once the flood peak has passed, there is a transition from response to recovery activities. Decisions about the management of residual water are likely to be required during the transition period.

Early planning for the management of residual water and the implementation of actions can begin during the response period, provided it does not interfere with response activities.

The key decisions are when (and if) to start removing floodwater and when to stop. Intervention is required if existing drainage is not expected to remove the water in time to prevent unacceptable risks to life, human health, community well-being, or economic activity. Intervention should stop once these risks have been reduced to tolerable levels.

Intervention also involves risks. These include workplace safety, and damage to property and the environment. There is also a risk of community frustration if pumping priorities do not match community expectations. Intervention can also create community expectations about pumping priorities and that pumping will continue until all flood waters have been removed, which may not be practical or possible.

Accountability 21a:

- DEPI is accountable for maintaining guidelines for managing residual floodwater.



Pumping residual water from fields near Mildura. Source: Mallee Catchment Management Authority.

Acronyms

AAD	Average annual damage
AEP	Annual exceedance probability
ARI	Average recurrence interval
ARR	Australian rainfall runoff
BCA	Building Code of Australia
BoM	Bureau of Meteorology
CMA	Catchment Management Authority
DEPI	Department of Environment and Primary Industry
DFE	Design flood event
DoH	Department of Health
DTPLI	Department of Transport, Planning and Local Infrastructure
ENRC	Environment and Natural Resources Committee
FIP	flood intelligence platform
IGEM	Inspector General for Emergency Management
ISRG	Interdepartmental Stakeholder Reference Group
LGA	Local Government Authority
LPPF	Local Planning Policy Framework
MFEP	Municipal Flood Emergency Plan
MSS	Municipal Strategic Statements
MW	Melbourne Water
RAM	Rapid Appraisal Method
RCB	Regional Coastal Board
SES	Victoria State Emergency Service
SPPF	State Planning Policy Framework
TFWS	Total Flood Warning System
VCIRIS	Victorian Critical Infrastructure Resilience Interim Strategy
VCS	Victorian Coastal Strategy
VFD	Victorian Flood Database
VFMS	Victorian Floodplain Management Strategy
VFR	Victorian Floods Review
VPP	Victorian Planning Provisions
WWCM	Whole-of-Water-Cycle Management

Glossary

Adaptation

Adjustment in response to actual or expected climate change or its effects, which moderates harm or exploits beneficial opportunities.

Annual exceedance probability (AEP)

The likelihood of the occurrence of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood flow of 500 m³/s has an AEP of 5%, it means that there is a 5% chance (that is, a one-in-20 chance) of a flow of 500 m³/s or larger occurring in any one year (see also *average recurrence interval, flood risk, likelihood of occurrence, probability*).

Average annual damage (AAD)

Depending on its size (or severity), each flood will cause a different amount of flood damage to a flood-prone area. AAD is the average damage per year that would occur in a nominated development situation from flooding over a very long period of time. If the damage associated with various annual events is plotted against their probability of occurrence, the AAD is equal to the area under the consequence–probability curve. AAD provides a basis for comparing the economic effectiveness of different management measures (i.e. their ability to reduce the AAD).

Average recurrence interval (ARI)

A statistical estimate of the average number of years between the occurrence of a flood of a given size or larger than the selected event. For example, floods with a flow as great as or greater than the 20-year ARI (5% AEP) flood event will occur, on average, once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event (see also annual exceedance probability).

Australian rainfall and runoff (ARR)

ARR is a national guideline for the estimation of design flood characteristics in Australia published by Engineers Australia. ARR aims to provide reliable (robust) estimates of flood risk to ensure that development does not occur in high risk areas and that infrastructure is appropriately designed. The edition is currently being revised. The revision process includes 21 research projects, which have been designed to fill knowledge gaps that have arisen since the 1987 edition was published.

Avulsion

The rapid abandonment of a river channel and the formation of a new river channel. Avulsions occur as a result of channel slopes that are much lower than the slope that the river could travel if it took a new course. Avulsions typically occur during large floods that carry the power necessary to rapidly change the landscape.

Catchment

The area of land draining to a particular site. It is related to a specific location and includes the catchment of the main waterway as well as any tributary streams.

Coastal erosion

Short-term retreat of sandy shorelines as a result of storm effects and climatic variations.

Coastal flooding (inundation)

Flooding of low-lying areas by ocean waters, caused by higher than normal sea level, due to tidal or storm-driven coastal events, including storm surges in lower coastal waterways.

Coastal hazard assessments

Coastal hazard assessments commonly define the extent of land expected to be threatened by coastal hazards (inundation, coastal erosion, coastal recession) over specific planning periods. They are typically used for development assessment purposes and to inform land-use planning considerations. In particular such assessments include consideration of future sea level rise scenarios, typically to the year 2100.

Consequence

The outcome of an event or situation affecting objectives, expressed qualitatively or quantitatively. Consequences can be adverse (e.g. death or injury to people, damage to property and disruption of the community) or beneficial.

Curtilage

The land occupied by a dwelling and its yard, outbuildings, etc, actually enclosed or considered as enclosed.

Design flood event

In order to identify the areas that the planning and building systems should protect new development from the risk of flood, it is necessary to decide which level of flood risk should be used. This risk is known as the design flood event.

Development

Development may be defined in jurisdictional legislation or regulation. This may include erecting a building or carrying out of work, including the placement of fill; the use of land, or a building or work; or the subdivision of land.

New development is intensification of use with development of a completely different nature to that associated with the former land use or zoning (e.g. the urban subdivision of an area previously used for rural purposes). New developments generally involve rezoning, and associated consents and approvals. Major extensions of existing urban services, such as roads, water supply, sewerage and electric power may also be required.

Infill development refers to the development of vacant blocks of land within an existing subdivision that are generally surrounded by developed properties and is permissible under the current zoning of the land.

Redevelopment refers to rebuilding in an existing developed area. For example, as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either rezoning or major extensions to urban services.

Flash flooding

Flooding that is sudden and unexpected, often caused by sudden local or nearby heavy rainfall. It is generally not possible to issue detailed flood warnings for flash flooding. However, generalised warnings may be possible. It is often defined as flooding that peaks within six hours of the causative rain.

Flood

Flooding is a natural phenomenon that occurs when water covers land that is normally dry. It may result from coastal or catchment flooding, or a combination of both (see also *catchment flooding and coastal flooding*).

Flood awareness

An appreciation of the likely effects of flooding, and a knowledge of the relevant flood warning, response and evacuation procedures. In communities with a high degree of flood awareness, the response to flood warnings is prompt and effective. In communities with a low degree of flood awareness, flood warnings are liable to be ignored or misunderstood, and residents are often confused about what they should do, when to evacuate, what to take with them and where it should be taken.

Flood class levels

The terms minor, moderate and major flooding are used in flood warnings to give a general indication of the types of problems expected with a flood

Minor flooding: Causes inconvenience. Low-lying areas next to watercourses are inundated which may require the removal of stock and equipment. Minor roads may be closed and low-level bridges submerged.

Moderate flooding: In addition to the above, the evacuation of some houses may be required. Main traffic routes may be covered. The area of inundation is substantial in rural areas requiring the removal of stock.

Major flooding: In addition to the above, extensive rural areas and/or urban areas are inundated. Properties and towns are likely to be isolated and major traffic routes likely to be closed. Evacuation of people from flood-affected areas may be required.

Flood damage

The tangible (direct and indirect) and intangible costs (financial, opportunity costs, clean-up) of flooding. Tangible costs are quantified in monetary terms (e.g. damage to goods and possessions, loss of income or services in the flood aftermath). Intangible damages are difficult to quantify in monetary terms and include the increased levels of physical, emotional and psychological health problems suffered by flood-affected people that are attributed to a flooding episode.

Flood education

Education that raises awareness of the flood problem, to help individuals understand how to manage themselves and their property in response to flood warnings and in a flood event. It invokes a state of flood readiness.

Flood emergency management

Emergency management is a range of measures to manage risks to communities and the environment. In the flood context, it may include measures to prevent, prepare for, respond to and recover from flooding.

Flood emergency management plan

A sub-plan of a flood-prone municipality's Municipal Emergency Management Plan. It is a step-by-step sequence of previously agreed roles, responsibilities, functions, actions and management arrangements for the conduct of a single or series of connected emergency operations. The objective is to ensure a coordinated response by all agencies having responsibilities and functions in emergencies.

Flood hazard

Potential loss of life, injury and economic loss caused by future flood events. The degree of hazard varies with the severity of flooding and is affected by flood behaviour (extent, depth, velocity, isolation, rate of rise of floodwaters, duration), topography and emergency management.

Flood peaks

The maximum flow occurring during a flood event past a given point in the river system (see also *flow* and *hydrograph*). The term may also refer to storm-induced flood peaks and peak ocean or peak estuarine conditions.

Flood-prone land

Land susceptible to flooding by the largest probable flood event. Flood-prone land is synonymous with the floodplain. Floodplain management plans should encompass all flood-prone land rather than being restricted to areas affected by defined flood events.

Flood proofing of buildings

A combination of measures incorporated in the design, construction and alteration of individual buildings or structures that are subject to flooding, to reduce structural damage and potentially, in some cases, reduce contents damage.

Flood readiness

An ability to react within the effective warning time (see also flood awareness and flood education).

Flood risk

The potential risk of flooding to people, their social setting, and their built and natural environment. The degree of risk varies with circumstances across the full range of floods. Flood risk is divided into three types – existing, future and residual.

Existing flood risk refers to the risk a community is exposed to as a result of its location on the floodplain.

Future flood risk refers to the risk that new development within a community is exposed to as a result of developing on the floodplain.

Residual flood risk refers to the risk a community is exposed to after treatment measures have been implemented. For example: a town protected by a levee, the residual flood risk is the consequences of the levee being overtopped by floods larger than the design flood; for an area where flood risk is managed by land-use planning controls, the residual flood risk is the risk associated with the consequences of floods larger than the DFE on the community.

Flood severity

A qualitative indication of the 'size' of a flood and its hazard potential. Severity varies inversely with likelihood of occurrence (i.e. the greater the likelihood of occurrence, the more frequently an event will occur, but the less severe it will be). Reference is often made to major, moderate and minor flooding (see also flood class levels).

Flood study

A comprehensive technical investigation of flood behaviour. It defines the nature of flood hazard across the floodplain by providing information on the extent, depth and velocity of floodwaters, and on the distribution of flood flows. The flood study forms the basis for subsequent management studies and needs to take into account a full range of flood events up to and including the largest probable flood. Flood studies should provide new flood mapping for planning scheme inclusion, data and mapping for MEMPs, and a preliminary assessment into possible structural and non-structural flood mitigation measures.

Flood warning

A Total Flood Warning System (TFWS) encompasses all the elements necessary to maximise the effectiveness of the response to floods. These are data collection and prediction, interpretation, message construction, communication and response.

Effective warning time refers to the time available to a flood-prone community between the communication of an official warning to prepare for imminent flooding and the loss of evacuation routes due to flooding. The effective warning time is typically used for people to move farm equipment, move stock, raise furniture, transport their possessions and self-evacuate.

Floodplain

An area of land that is subject to inundation by floods up to and including the largest probable flood event – that is, flood-prone land.

Floodplain management

The prevention activities of flood management together with related environmental activities (see also *floodplain*).

Flow

The rate of flow of water measured in volume per unit time – for example, cubic metres per second (m³/s). Flow is different from the speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).

Freeboard

The height above the DFE or design flood used, in consideration of local and design factors, to provide reasonable certainty that the risk exposure selected in deciding on a particular DFE or design flood is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest heights and so on. Freeboard compensates for a range of factors, including wave action, localised hydraulic behaviour and levee settlement, all of which increase water levels or reduce the level of protection provided by levees. Freeboard should not be relied upon to provide protection for flood events larger than the relevant design flood event. Freeboard is included in the flood planning controls applied to developments by local councils.

Frequency

The measure of likelihood expressed as the number of occurrences of a specified event in a given time. For example, the frequency of occurrence of a 20% annual exceedance probability or five-year average recurrence interval flood event is once every five years on average (see also *annual exceedance probability*, *annual recurrence interval*, *likelihood and probability*).

Hazard

A source of potential harm or a situation with a potential to cause loss. In relation to this handbook, the hazard is flooding, which has the potential to cause damage to the community.

Hydraulics

The study of water flow in waterways; in particular, the evaluation of flow parameters such as water level, extent and velocity.

Hydrology

The study of the rainfall and runoff process, including the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.

Intolerable risk

A risk that, following understanding of the likelihood and consequences of flooding, is so high that it requires consideration of implementation of treatments or actions to improve understanding of, avoid, transfer or reduce the risk.

Likelihood

A qualitative description of probability and frequency (see also *frequency and probability*).

Likelihood of occurrence

The likelihood that a specified event will occur. (With respect to flooding, see also *annual exceedance probability and average recurrence interval*).

Local overland flooding

Inundation by local runoff on its way to a waterway, rather than overbank flow from a stream, river, estuary, lake or dam. Can be considered synonymous with stormwater flooding.

Mitigation

Permanent or temporary measures (structural and non-structural) taken in advance of a flood aimed at reducing its impacts.

Planning scheme zones and overlays

Planning schemes set out the planning rules – the state and local policies, zones, overlays and provisions about specific land uses that inform planning decisions. Land use zones specify what type of development is allowed in an area (e.g. urban (residential, commercial, industrial), rural, environmental protection). Overlays specify extra conditions for developments that are allowed in a zone. For example, flooding overlays specify that developments must not affect flood flow and storage capacity of a site, must adhere to freeboard requirements, and not compromise site safety and access.

Probability

A statistical measure of the expected chance of flooding. It is the likelihood of a specific outcome, as measured by the ratio of specific outcomes to the total number of possible outcomes. Probability is expressed as a number between zero and unity, zero indicating an impossible outcome and unity indicating an outcome that is certain. Probabilities are commonly expressed in terms of percentage. For example, the probability of ‘throwing a six’ on a single roll of a die is one in six, or 0.167 or 16.7% (see also *annual exceedance probability*).

Rainfall intensity

The rate at which rain falls, typically measured in millimetres per hour (mm/h). Rainfall intensity varies throughout a storm in accordance with the temporal pattern of the storm (see also *temporal pattern*).

Regional Coastal Boards

Members of Victoria’s three coastal boards have been appointed by the Minister for Environment and Climate Change because of their experience and expertise in areas such as local government, coastal planning and management, tourism and recreational use of the coast. The functions of the Western, Central and Gippsland Coastal Boards, set out under the *Coastal Management Act 1995*, include developing regional coastal plans and providing advice to the Minister on regional coastal development issues.

Risk analysis

Risk is usually expressed in terms of a combination of the consequences of an event and the associated likelihood of its occurrence. Flood risk is based upon the consideration of the consequences of the full range of flood events on communities and their social settings, and the natural and built environment (see also *likelihood and consequence*).

Risk management

The systematic application of management policies, procedures and practices to the tasks of identifying, analysing, assessing, treating and monitoring flood risk.

Riverine flooding

Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam. Riverine flooding generally excludes watercourses constructed with pipes or artificial channels considered as stormwater channels.

Runoff

The amount of rainfall that drains into the surface drainage network to become stream flow; also known as rainfall excess.

Storm surge

The increases in coastal water levels above the predicted tide level resulting from a range of location dependent factors such as wind and waves, together with any other factors that increase tidal water level.

Stormwater flooding

The inundation by local runoff caused by heavier than usual rainfall. It can be caused by local runoff exceeding the capacity of an urban stormwater drainage systems, flow overland on the way to waterways or by the backwater effects of mainstream flooding causing urban stormwater drainage systems to overflow (see also *local overland flooding*).

Victoria State Emergency Services (SES)

SES is a volunteer-based organisation that provides emergency assistance to the community. SES is the control agency during emergency responses to floods, storms, earthquakes and tsunamis in Victoria, and is the largest provider of road rescue in the state. It also assists as a support agency during other emergencies such as fire.

Vulnerability

The degree of susceptibility and resilience of a community, its social setting, and the natural and built environments to flood hazards. Vulnerability is assessed in terms of ability of the community and environment to anticipate, cope and recover from flood events. Flood awareness is an important indicator of vulnerability (see also *flood awareness*).

Water Management Scheme

The formal process set out in the *Water Act 1989* that can be applied to a flood mitigation infrastructure development and its ongoing management. It can be based on and carried out in parallel with a floodplain management study.

Customer Service Centre **136 186**

www.depi.vic.gov.au