Victorian Flood Data and Mapping Guidelines

Acknowledgement of Victoria’s Aboriginal communities

The Victorian Government proudly acknowledges Victoria’s Aboriginal communities and their rich culture; and pays

its respects to their Elders past and present. The government also recognises the intrinsic connection of Traditional

Owners to Country and acknowledges their contribution in the management of land, water and resources.

We acknowledge Aboriginal people as Australia’s first peoples and as the Traditional Owners and custodians of

the land and water on which we rely. We recognise and value the ongoing contribution of Aboriginal people and

communities to Victorian life and how this enriches us. We embrace the spirit of reconciliation, working towards the

equality of outcomes and ensuring an equal voice.

These guidelines were developed by the Department of Environment Land Water and Planning (DELWP) with Jacobs

Group Australia and a project steering committee representing agencies with floodplain management functions.

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Introduction

The Victorian Floodplain Management Strategy (VFMS),

launched on 20 April 2016 by the Minister for Water

Lisa Neville acknowledges that flooding is an inevitable

natural hazard in Victoria. Whether the source of

flooding is heavy rainfall, coastal storms or overflowing

rivers, floods will continue to occur.

Fortunately, well-designed, contemporary flood studies

and regular flood data collection can be used to predict

the likelihood and impact of floods with reasonable

accuracy.

DELWP has prepared the Victorian Flood Data and

Mapping Guidelines to guide delivery of flood maps

and flood data collection activities that align with the

accountabilities, policies and actions set out in the VFMS.

Part 1 promotes a consistent approach to preparing flood

studies that help communities consider their options

for flood management. The guidelines recognise that

the nature, cause and scale of flood risk varies between

locations and communities, so they do not attempt to

prescribe a single approach. Instead, project managers

are encouraged to draw on advice and guidance on

current best practice and previous experiences.

Following widespread floods in Victoria during 2010 and

2011 the Victorian Government commissioned a review

(led by Neil Comrie) of arrangements for flood response,

flood recovery, emergency warnings and evacuations.

The Comrie Review noted the importance of regularly

collecting data after a flood to improve understanding

of flood behaviour for a range of purposes including

updating flood plans, identifying gaps in flood warning

systems, and enhanced land use planning.

Part 2 of the guidelines reviews historic arrangements

for coordination of flood data collection, and provides

a guide for developing locally agreed, documented and

understood processes for future data collection efforts.

Information provided includes a generic list of data types

to be collected, agency roles, and triggers for decisions

about whether or not a significant investment in post

flood data effort is warranted.

During the guidelines’ development, a range of local

government sources – including planning, infrastructure

management, engineering and emergency management

– contributed valuable advice about preparing flood

maps. While some of the responses related to matters

outside the intended scope of the guidelines, the project

steering group considered that it was important that

these ideas where not lost.

Part 3 provides a summary of issues raised by local

government, and the steering group’s response to those

issues. A key message from Part 3 is that the guidelines

are a supporting resource for local governments

undertaking flood studies, and will not impose additional

costs in the majority of cases.

The Victorian Flood Data and Mapping Guidelines

provide a reference for flood risk mapping and flood data

collection activities that align with Victorian Government

policy set out in the VFMS. They set a standard for flood

mapping in Victoria to meet the needs of a range of

users, including land use planning, assessing risks to

Aboriginal cultural heritage, insurance and emergency

response. The guidelines should be used as the basis for

an agreed and consistent approach to flood mapping and

flood data collection between study investors, project

managers and local communities.

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FloodZoom image showing

1% AEP flood extent around

Nathalia. Source: DELWP

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Appendix A. Examples of flood mapping standards/guidelines

available in other locations

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Part 1

1. Introduction

Widespread floods in Victoria during 2010 and 2011 led

to the Victorian Government commissioning a review

(led by Neil Comrie) of arrangements for flood response,

flood recovery, emergency warnings and evacuations.

One component of the government’s response to the

Review’s recommendations was a commitment to

develop guidelines for standardisation of flood mapping.

This document forms these guidelines.

The guidelines promote a standardised approach to flood

mapping in Victoria, whether the source of flooding is

riverine, stormwater or coastal. They set a standard for

flood mapping to meet the needs of a range of users,

including land use planning, assessing risks to Aboriginal

cultural heritage, insurance and emergency response.

The guidelines also provide some general guidance on

preparation of electronic and hard copy flood mapping

products, and considerations for revising flood mapping

in response to new or changed information.

This document should be used as the basis for an agreed

and consistent approach to flood mapping between

flood study investors, project managers and steering

committees. The guidelines do not specify techniques to

be used to prepare flood mapping products and should

be read in conjunction with other relevant reference

documents, particularly Australian Rainfall and Runoff

(currently under revision) and Australian Emergency

Management Handbook 7, Managing the Floodplain:

A guide to best practice in flood risk management in

Australia.

Concrete levee on Creswick Creek.

Source: Simone Wilkinson, DELWP

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Part 1

2. Background and context

2.1 The Victorian Floods Review

and response

Flood maps that were used for emergency response

during the 2010-11 floods were variable in both quality

and quantity. Some did not contain critical details,

such as information on which roads would be cut off

and which would be passable at different flood levels.

Many maps used for the emergency response had been

created primarily with land use and building planning

in mind, with less thought given to their use during an

emergency.

Flood studies that produced many of these maps were

funded without clear agreement between investors and

proponents on the data and mapping outputs that would

be produced. In addition, maps were frequently not

updated to reflect significant changes to the floodplain,

such as construction of roads and changes to levees.

The Victorian Floods Review (the Comrie Review)

identified inconsistences in standard practices for flood

mapping across Victoria:

> Recommendation 21: The state establish

standards for flood mapping to ensure they are

kept contemporary and meet the purposes of

land use risk planning and emergency response. In

doing so, maps should extend where appropriate

to include Probable Maximum Flood, over a range

of Annual Exceedance Probability (AEP) levels and

be explicitly linked to a stream gauge.

The Comrie Review was focused on riverine flooding.

However, the principles of flood mapping taking account

of local knowledge, meeting the needs of a range of

users, and extending across both moderate and extreme

floods are also relevant for coastal and stormwater

flooding.

2.2 Standards for flood mapping

These guidelines promote a consistent standard for flood

mapping in Victoria. Consistency will improve the ways

flood information is shared and used by individuals,

government agencies and other organisations involved in

floodplain management. Flood studies that are prepared

with government financial assistance will need to meet

this standard by:

• developing flood maps in consultation with local

communities to make use of local knowledge

• covering a range of flood extents, from moderate to

extreme, as well as historic floods

• referring to the most recent edition of Australian

Rainfall and Runoff – A Guide to Flood Estimation and

Australian Emergency Management Handbook 7,

Managing the Floodplain: A guide to best practice in

flood risk management in Australia

• taking into account the State Planning Policy

Framework (SPPF) strategies where relevant, including

to plan for and manage the potential coastal impacts

of climate change

• ensuring maps are vetted by the relevant CMA or

Melbourne Water

• consulting with Aboriginal communities to ensure

cultural values are considered in assessing and

mapping flood risks

• providing maps in the correct format for storage in the

Victoria Flood Database (VFD)

• providing flood information at a property scale that

can be used, understood and disseminated by flood

emergency services agencies.

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2.3 Flood studies

Flood studies aim to provide data that can be used

to develop products for flood response and help

manage risks to the community. They involve the use

of hydrologic and hydraulic models to determine flood

flows, levels and velocities for a range of design flood

Annual Exceedance Probabilities (AEPs). The models are

usually calibrated to one or more historic flood events,

where applicable data or other information is available

on peak flow rates and water levels. The modelling

results are used to determine flood hazard (often

expressed as a velocity – depth- product), flood damages

and ultimately flood risk (expressed as the product of

probability and consequence of occurrence).

Until around 2000, flood studies were primarily

undertaken to meet the planning and flood mitigation

needs of Catchment Management Authorities,

Melbourne Water and local government. They typically

involved an assessment of the 1% AEP flood event in

relation to its extent and depth.

Since 2000, and particularly since the floods of 201011,

flood studies have had an increased focus on the

modelling and mapping of a range of flood events. There

is also an increased focus on mapping flood class levels

(i.e. minor, moderate and major) where they exist, and

also linking flood maps to local gauge levels.

2.4 Approaches to flood mapping

Approaches to flood mapping vary, depending on the

location and available resources. This section documents

some of these approaches. References to guideline

documents are provided in more detail in Appendix A.

2.4.1 Victoria

Within Victoria, there is no generally adopted, consistent

technical approach to flood mapping. Melbourne Water

has guidelines and technical specifications that are used

for its flood studies. These guidelines have been adopted

and used by some local governments.

The data and mapping outputs produced by flood

studies depend on available resources and the needs

of project investors and the steering committee. The

standard of flood mapping has progressed over recent

decades in response to advances in modelling techniques

and software capability. In the past there has been no

consistent standard for flood studies and the focus

has tended to be on information needed for planning

and building controls. Since the 1998 Victoria Flood

Management Strategy was released there has been a

growing trend to map a range of floods and to consider

not just planning and building control requirements, but

also emergency management needs.

Recommendation 21 of the Comrie review notes that, at

the time of the review, general guidance was available

for producing flood maps, but no formal standards or

processes. Since the review, flood mapping projects

prepared with financial assistance from the Victorian

Government have been required to meet a range of

purposes, including land use planning and emergency

response, and address the other key Comrie review

recommendations to:

• consult with the community to capture local

knowledge and verify maps

• map multiple AEPs, including moderate through to

extreme floods

• link flood maps to stream gauges where possible

• identify the impacts of flooding on key infrastructure.

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Flood data in Victoria can be accessed from the Victoria

Flood Database (VFD), including historic and modelled

flood levels and extents. The VDF is continually improved

and added to, and consultants producing flood studies

in Victoria are required to deliver data to the VFD as GIS

layers at the completion of the study.

Flood studies in Victoria use the technical guidance

provided in Australian Rainfall and Runoff and Australian

Emergency Management Handbook 7, Managing

the Floodplain: A guide to best practice in flood risk

management in Australia.

2.4.2 Interstate

Elsewhere within Australia, flood mapping guidelines

are not usually available. NSW floodplain management

is driven by the Floodplain Development Manual (2005);

other relevant documents include the SES requirements

from the FRM (Flood Risk Management) Process (2007).

The Queensland Floods Commission of Inquiry has

recommended that flood mapping guidelines be created

for Queensland.

Copies of many Australian flood studies are available

for download from Geoscience Australia’s flood studies

database.

2.4.3 International

The European Exchange Circle on Flood Mapping has

guidelines for flood mapping from an emergency

management and planning perspective. The US Federal

Emergency Management Agency also has guidelines

that specify the information required in each type of

flood map.

2.5 Review of national guidelines

In 2012, the Commonwealth Attorney-General’s

Department released the National Guidelines for

the National Flood Risk Information Program (NFRIP,

2012). These guidelines were developed to “provide

a framework to guide organisations in providing

information to the National Flood Risk Information

Portal”. Of the six guiding principles, one is of particular

relevance:

Standardised – Information will use nationally

consistent terminology, will cover a range of flood

likelihood and sources, will be presented in standard

formats and will be consistent across all jurisdictions.

Relevant agencies will be encouraged to adopt best

practice and incorporate the guidelines and lessons

learnt into future contributions to the Portal.

(NFRIP, 2012)

The other guiding principles are: shared, open,

accessible, risk-based and innovative.

The Victorian Guidelines for Standardisation of Flood

Mapping have been developed in recognition of

the national guidelines and to ensure that Victoria’s

approach does not contradict the national guidelines.

The 2012 national guidelines do not provide any specific

guidance on desirable content of flood maps and are not

prescriptive.

Since then, the National Flood Risk Advisory Group

(NFRAG), a reference group of the Australian and New

Zealand Emergency Management Committee (ANZEMC),

has led the development of a generic project brief

and technical specifications for flood investigations.

NFRAG has also produced a guideline for using the

generic project brief, and Victorian project managers are

encouraged to use these documents when planning their

own flood studies.

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3. Requirements for flood mapping

The outputs from flood studies are used to create

products to meet a range of needs. The National Flood

Risk Advisory Group (NFRAG) has developed a National

Generic Brief for Flood Investigations (July 2014), and a

Guideline for using the National Generic Brief for Flood

Investigations to Develop Project Specific Specifications

(June 2014). These documents include guidance on

desirable flood study outputs. Priorities for new and

revised flood mapping will be identified through regional

floodplain management strategies

Outputs from a flood study are used to:

• define flood-related controls in municipal planning

schemes

• develop flood intelligence products and inform

emergency response planning

• design flood mitigation works and activities

• assist in the preparation of community flood

awareness and education products

• assess flood risks to Aboriginal cultural heritage,

significant places and landscapes

• support the assessment of flood risk for insurance

purposes.

This section reviews the main uses for flood mapping and

other flood study outputs and makes recommendations

to help project managers meet these requirements.

Uniformity across multiple projects enables rapid

familiarisation of project mapping during times of

emergency – a critically important product use. Project

managers should consider this when developing project

specifications.

3.1 What flood mapping is used for

3.1.1 Land use and development planning

Local government authorities are responsible for

land use planning and assessment of development

applications on areas of flood prone land. An assessment

of a proposed new development or change of land use in

these areas needs to consider:

• the suitability of a proposed land use or development

with respect to the applicable flood risk, and what

level of flood protection needs to be applied

• whether the proposed development is likely to

increase the flood risk to surrounding land users.

Local government authorities consider advice from

catchment management authorities and Melbourne

Water in assessing planning permit applications in areas

within the 1% AEP flood extent. CMAs and Melbourne

Water require access to flood extent, depth and velocity

information to provide this advice.

3.1.2 Planning schemes

The delineation of planning scheme controls and building

regulations is informed by mapped flood extents and

flood hazard outputs. Local government authorities are

responsible for ensuring that areas at risk of flooding in

a 1% AEP flood are identified in their planning schemes.

Planning scheme maps need access to 1% AEP flood

extent and flood hazard data.

3.1.3 Flood mitigation and emergency planning

Flood mitigation and emergency planning activities

typically have similar requirements and use similar data

sets. The key stakeholders in development of these

products include VICSES, local government authorities

and affected communities.

Flood mitigation and emergency planning activities need

access to flood risk and flood consequence data. This

will include flood extents, depths, and velocities along

with associated impacts and consequences for a range

of flood magnitudes (AEPs) including moderate flooding

through to extreme floods, as well as historic events.

Studies need to consider travel times for emergency

planning, recessions and post drainage to assist with

recovery.

Flood mitigation also needs to integrate protection of

high-value waterways and wetlands, benefits of flooding

on agricultural land and the natural environment, and

Aboriginal cultural heritage and significant places.

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3.1.4

Emergency response and community

education

Emergency response needs information that is clear, easy

to understand, and easily accessed and shared during an

emergency. VICSES and affected communities need to be

able to link predicted or forecast flood timing and levels

to local flood warning stream gauges to understand how

they may be affected. DELWP has developed a web-

based flood intelligence platform, FloodZoom, to be used

by flood response agencies to access this information

during floods. VICSES also produces printed and on-line

flood awareness material tailored to the needs of each

affected community.

3.1.5

Other uses

Insurance premiums may be informed by information

on property flood risk assessed against data for a range

of flood magnitudes. A range of other stakeholders use

flood mapping information for various purposes. For

example, VicRoads may access this data to determine

roads and other assets that are vulnerable to flooding

or to determine whether roads projects are likely to

affect existing flood levels. Other users may include

environmental flow managers, who may use flood

mapping information as part of the decision-making

process for timing and magnitude of environmental flow

releases.

Flow depth gauge board at Benjaroop. Photo. Rohan Oliver, Ventia

3.2

Data outputs and formatting

guidelines

Given the wide range of uses and users, requirements

for data formatting will vary from flood study to flood

study and need to be set out in project specifications.

Ideally, all project partners, including local community

members, should have the chance to have input to the

specification. This document provides some guidance

on what has been found to work well in previous

experience, but these decisions are generally left up to

flood project partners.

All flood studies should include a plan for community

engagement and consultation to incorporate local

knowledge and verification in the flood maps.

Melbourne Water or the relevant CMA must also vet

flood maps and other flood study outputs before they

are published for use.

3.2.1

Digital information – Geographic

Information Systems

Digital outputs may include both model outputs and

post-modelling derived outputs. The required format,

including software requirements, will depend on project

partners’ requirements.

All GIS outputs for riverine flood mapping prepared with

government financial assistance must be submitted

for inclusion in the Victoria Flood Database (VFD).

Information about submitting data for inclusion in the

VFD and the FloodZoom platform are available from the

DELWP website.

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3.2.2 Static information – hard copy and

electronic maps and other products

The need for printed hard copy maps is best determined

by VICSES. VICSES may require hard copy maps at A1

or larger sizes to provide redundancy for electronic

systems in case communication or electricity services are

lost during an emergency. If hard copy maps are to be

requested, the flood study specification needs to detail

these requirements, and whether the maps need to be

submitted in both electronic and printed format.

VICSES has developed a specification for preparation

of maps used for emergency planning and response.

It has also developed a specification that guides the

population of municipal flood emergency plan mapping

products. VICSES project group representatives can

provide the project managers with the latest version of

the specification to include in the flood mapping project

specification.

Maps and documentation produced to update a

planning scheme need to be in the format required by

DELWP. Guides to the production of planning scheme

amendment maps and documentation are available from

the DELWP website.

3.3 Flood intelligence products

and outputs

Flood intelligence products provide explanatory detail on

how the mapping outputs were derived; flood behaviour

mapping projects should address what they mean and

how to interpret them. These products include a study

report and flood intelligence outputs. Following are

examples of flood intelligence outputs.

3.3.1 Municipal Flood Emergency Plan

The appendices of the Municipal Flood Emergency

Plan (MFEP) template set out the type of data used

by emergency services agencies in planning for, and

responding to, flood events. The MFEP provides location-

specific information on flood history, the local flood

regime and critical areas of high flood risk and is an

invaluable resource for flood analysts during a flood

emergency. All flood intelligence outputs from flood

studies can be presented in the MFEP, ensuring that this

critical information is not buried in a highly technical

flood study report.

MFEPs and associated mapping are developed using the

VICSES template and specifications, available from the

VICSES website.

3.3.2 Community education

A range of community education products can be

prepared to supplement flood mapping projects. These

may take the form of local guides that provide key

information on local flood history, the flood mapping

process, anecdotal information from residents and an

overview of flood mitigation measures.

The need for, and format of, such guides is best

determined by VICSES and community representatives.

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3.3.3 Flood damages and mitigation

assessment

A flood damage assessment should be undertaken

as part of a flood study. Flood damage assessments

determine the costs associated with flooding and are

completed for a range of AEPs so as to determine a

locality’s actual flood risk.

This information is valuable from a floodplain

management and emergency planning perspective as

it identifies any areas where flood risk is intolerable

and may require additional mitigation measures. It is

also important to local government, as it provides an

understanding of the potential financial burden on

communities from various AEP events.

Providing this information will allow local government

to assess the impact and costs to their communities

associated with flooding, compared to the costs of

constructing flood mitigation works. These assessments

can in turn be used to support submissions for funding

support from state and Australian governments.

Flood studies should also include an assessment of

the effectiveness of any existing flood mitigation

infrastructure. If possible, this should include an

assessment of the impact of removal or failure of these

works.

3.3.4 Flood warning

Effective flood warnings provide information about

when and where flooding is expected to occur and

what community members can do to reduce damages.

An assessment of flood warning service needs should

be undertaken, including consideration of existing

arrangements and the potential benefits of new or

revised arrangements. This assessment can be later used

to inform the design and implementation of a locally

specific Total Flood Warning System.

3.4 Land use planning and

building outputs

The results of flood studies are an important input in the

development of flood-related planning scheme zones

and overlays, and building controls.

Development and maintenance of these zones and

overlays requires access to high-quality, contemporary

flood information, principally flood extents for the 1%

AEP event. Building regulations also require flood extent,

velocity and hazard data.

Flood studies should consider the need to update

the local planning scheme to reflect new flood risk

mapping, and where an amendment is needed prepare

documentation for the amendment.

DELWP provides a range of Planning Practice notes to

assist with application of the Victoria Planning Provisions

(VPP) and planning schemes as well as a range of

planning processes and topics. Practice Note 12 (PPN12:

Applying the Flood Provisions in Planning Schemes)

provides guidance about applying the flood provisions

in planning schemes. DELWP Practice Notes can be

accessed from the DELWP website.

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Part 1

4. General guidelines on map presentation

This section discusses some of the many elements that

ensure that flood maps achieve their stated purpose,

convey the right information to the target audience, and

are visually clear and appealing.

An effort has been made not be overly prescriptive

around the detail of visual information and presentation

style. The intention is to enable enough flexibility to

allow for the preferences of particular flood study

steering committees.

Some flood study stakeholders (including DELWP, VICSES,

Catchment Management Authorities and Melbourne

Water) have specific GIS workspaces for flood study data

and mapping. These workspaces typically mandate some

of the items discussed below and should be used where

available.

4.1 Map scale

Nominally, towns or locations of higher population and

infrastructure density should have a larger scale to allow

for easy reference of flood impacts.

Different scales may also be appropriate for land use

planning and emergency response maps. Readability is

clearly of paramount importance for hard copy maps.

Project partners may have particular requirements for

map scales. Typical map scales in urban areas may be

around 1 in 5,000 whereas lower-resolution scales of up

to 1 in 10,000 or even 1 in 20,000 may be appropriate for

rural areas. Where higher-resolution maps are required it

may be necessary to provide maps as a set or collection

to cover the entire area of interest. When doing this,

include a key map showing the layout of the individual

high-resolution maps, and some overlapping area on

each high-resolution map is preferred.

The scale at which flood modelling results are presented

can depend on the scale at which the modelling itself

was undertaken and the quality of the digital terrain

data on which it was based. It would not be credible to

attempt to present results from a flood model based

on a low resolution topographic grid cell size on a very

high-resolution, detailed flood map. Advice on selection

of the appropriate flood model topographic grid cell size

is available from the outcomes of the Australian Rainfall

and Runoff Revision Project 15.

All maps should include a bar scale. It may also be

desirable to include graticules depending on the scale

and content of the map.

4.2 Base layers

Base layers are the geographic information underlying

the flood extents or other flood information shown on

maps. They generally consist of data sets such as:

• road alignments (centre lines or greater detail on high-

resolution maps)

• alignments or locations of infrastructure such as

railways, levee banks, etc

• waterway alignments

• locations of lakes, wetlands and other water bodies

• land use, including state land, urban land, etc

• localities, town and place names for low-resolution maps

• topography, i.e. contours

• aerial photography

• cadastre, i.e. register of property titles

• water storages

• gauge locations

• features of interest.

Use of base layers is primarily designed to enable map

users to locate themselves and relate flood information

shown on the maps to actual locations. Where possible,

detailed and legible labelling of base layers should be

included on all maps, but this labelling should not clash

with, or detract from, the primary purpose of the maps.

Selection of appropriate base layers to be included on

any flood map will depend on the scale of the map, the

purpose, audience and quality of the available data sets.

Where practicable, labelling of as many base layer

features as possible should be included. This is most

easily done before the flood data itself is added, as it

allows for consistent labels across all maps in the same

set. Linear features such as roads and waterways should

be labelled with text parallel to the feature.

Formatting of the labels should be consistent and the

text colours can be adjusted to match the feature being

labelled.

Contours (if used as base map layers) should be labelled

so that both the scale and absolute value of any contour

on the map can be readily determined. Use of cadastre

layers on some maps may be inappropriate if the scale

resolution is too low.

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Part 1

4.3 Colour palette

Selection of an appropriate colour palette should

consider the following:

• Optimisation of the palette to ensure legibility

of the various data sets that are plotted on the

map. Reference should be made to the Victorian

Department of Planning and Community

Development’s Communicating Data with Colour

guideline, which has been produced to assist legibility

for people with colour blindness.

• Consistency of the palette between various maps in

the same set.

• When graded shading is used to define magnitude in a

data set, whether critical thresholds and values can be

easily interpreted from the shading.

• It can be difficult to distinguish between two shades of

the same colour; distinguishing between two different

colours is frequently easier. Guidance on appropriate

contrasts is available from Vision Australia.

• Typical convention uses blue/green to indicate

low magnitude or flood hazard, amber to indicate

moderate magnitude or flood hazard and red to

indicate high magnitude or flood hazard.

• If legibility of the map requires the user to distinguish

between two close shades or colours, there is probably

too much data on the map.

• A clear legend explaining the significance of each

colour. If a degree of transparency is used in

colourisation, ensure this is reflected in the legend.

4.4 Labelling maps

All maps should include basic items such as legend, scale,

north arrow and title. Map titles should include a clear

description of the data plotted on the map, and a subheading

that summarises the intention of the map.

Other basic information such as the date the map was

created, the organisations responsible for the map

(typically local government agency, CMA / Melbourne

Water and consultant) and the map revision number.

Where possible, flood study practitioners should include

textual information on maps. This is best done in a

clearly separated box and may include information such

as:

• further information about the purpose or uses of the

map

• identification of any limitations or uncertainties in the

plotted data

• a statement of reliance for the map and plotted data

• data source (e.g. study, year, consultant)

• useful local or anecdotal information that supplements

the map data.

Where this information is included, it should be carefully

edited to ensure that it states the key points without

dominating the plotted data.

The following gives sample text for identification of

limitations in the plotted data:

“No two floods behave in exactly the same manner

even though they may rise to the same maximum

height at a given location. The information given shall

be regarded as only representing typical conditions.

(North Central CMA, Castlemaine, Campbells Creek

and Chewton Flood Management Plan: RFT Part B –

Specification, November 2012)”

Take care with terminology on maps to minimise

confusion. This includes correct and consistent use

of flood probability terminology (e.g. ‘1% AEP’ is the

preferred approach) as well as clear labelling of items like

velocity (cross-sectional average or vectors) and depth of

inundation versus flood depth or peak depth.

Victorian Flood Data and Mapping Guidelines

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Part 1

5. Discussion

This section discusses some other aspects that should be

considered when planning and reviewing the lifecycle of

a flood map and its uses.

5.1

Non-structural flood mitigation

While the preparation of flood maps is an integral

component in assessing structural flood mitigation

options, making the information contained in the

maps available to the community is also important.

For example, a map showing flood extents and

consequences can be used to identify those areas

subject to the highest flood risk. Such maps are powerful

tools for interpreting flood forecasts, planning flood

responses and identifying safe access and egress routes

during a flood.

Flood maps are used in community flood awareness

activities and printed material promoting greater

understanding of the likelihood and consequences

of flooding for individuals, and how they can act to

reduce damages. Total flood warning system design also

incorporate flood maps, including making assessments of

suitable locations for new flood warning gauges.

Flood maps are also used to determine the numbers,

types, and locations of buildings that are affected at

different forecast or predicted flood levels.

5.2

Guidelines for review of

flood mapping

Flood maps are a snapshot at the point in time when

they were created. There will be developments and

changes that mean that the maps become less accurate

over time. These changes include:

• additional flooding resulting in better understanding of

flood behaviour

• changes in land use and population spread or density

• changes in flood modelling, mapping or analysis

techniques

• changes in key input data such as design rainfall

intensity-frequency-duration data (either as a result

of an update or via an external forcing factor such as

climate change)

• implementation of structural flood mitigation

measures

• availability of improved data sets, including

topographic data

• land form change including scour, erosion or

sedimentation of waterways, culverts and bridges

• infrastructure development, such as freeways, railways

and major buildings.

The decision to renew flood mapping depends on the

needs of stakeholders, and any agency with an interest

in flood mapping can raise the need for a review. CMAs

and Melbourne Water will lead development of regional

floodplain management strategies in collaboration with

local communities and partner agencies. These strategies

will continually review and align the various agencies’

priorities for new and revised flood mapping over a three

year rolling implementation plan.

Updating flood maps can involve a substantial update of

the existing modelling and analysis, so the costs need to

be considered. To minimise the cost of such updates, it is

recommended that local government capture and retain

electronic copies of the input data sets, models, maps

and calculation records that the flood study practitioner

used to create the maps. This will ensure that future

practitioners can more easily update these data sets.

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Part 1

5.3 Recognition of best practice

These guidelines seek to provide some advice on good

practice for flood mapping in Victoria and should be

read in conjunction with other reference documents.

Flood study methodologies should be consistent with the

advice provided in Australian Rainfall and Runoff. There

are a range of other technical guidelines that may be

relevant for flood study development.

For flood study steering committees, independent expert

review of technical methodology and outputs studies

is valuable. While this may add a small sum to the cost

of a flood study, such reviews can help ensure that best

practice in modelling, analysis and mapping has been

used.

5.4 Incorporating local knowledge

Recommendation 22 of the Victorian Floods Review

highlighted the importance of local information and

knowledge:

The state take the necessary measures to require that

local knowledge is considered in flood risk planning,

including verification of flood maps and flood

response plans.

Steering committees for flood studies are made up of

locally based stakeholders to ensure local knowledge

is incorporated in the flood study, and flood maps

are vetted by people who understand local flooding

behaviour. Such committees will include CMA /

Melbourne Water representatives, local government

representatives, emergency services representatives,

critical infrastructure managers, residents and business

owners.

CMA and Melbourne Water representatives will support

the local steering committee’s role in vetting maps and

other flood study outputs by reviewing and approving all

maps and outputs before they are published.

Flood marker at Breakwater Road, Geelong. Source: Simone Wilkinson, DELWP

Victorian Flood Data and Mapping Guidelines

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Part 1

Appendix A. Examples of flood mapping standards/

guidelines available in other locations

Queensland Floods Commission of Inquiry

The Commission of Inquiry identified that “emergency

management decision-making would benefit from access

to detailed flood maps which show floods over a range of

likelihoods – up to and including the probable maximum

flood” (QFCI, 2012). The inquiry recommended that

mapping be undertaken in areas with no mapping,

and that the Queensland Government determine the

appropriateness of existing guidelines for flood studies

and mapping, and create guidelines where needed

(recommendation 2.22).

The report documenting the Commission of Inquiry is

available at: http://www.floodcommission.qld.gov.au/

publications/final-report

NSW Floodplain Development Manual

Floodplain management in NSW is guided by the NSW

Floodplain Development Manual (2005). The manual

does not provide any guidance on flood mapping. As

a result, flood mapping undertaken currently differs

between projects. Some broad guidance on flood

mapping for emergency management purposes is

included in SES requirements from the FRM (Flood Risk

Management) Process (2007).

Queensland Reconstruction Authority

As part of its briefing documents, the Queensland

Reconstruction Authority (QRA) specifies mapping

requirements for flood mapping and layers required.

US Federal Emergency Management Agency

Over the past two decades, the US Federal Emergency

Management Agency (FEMA) has undertaken

identification and assessment of flood hazards along

with community based mapping of flood hazard

information (FEMA, 2003a). The guidelines outline the

information required to be presented on each type

of map along with additional optional information if

available (Section 1.4.2.3; FEMA, 2003b).

They are highly prescriptive, and specifically geared to US

system requirements.

These guidelines are available from: http://www.fema.

gov/library/viewRecord.do?id=2206

European Exchange Circle on Flood Mapping

The European Exchange Circle on Flood Mapping

(EXCIMAP) Handbook on good practices for flood

mapping in Europe (EXCIMAP, 2007) outlines map

requirements for planning and emergency management

maps, and outlines the type of map, map content, map

use, scale considerations and colour scheme for a variety

of map types.

The Handbook discusses different approaches used a

range of European countries, and provides guidance on

the types of information that should or could be used on

a range of different maps types for different purposes. It

refers essentially to four types of maps, with associated

broad purposes:

1. Flood hazard maps

• Landuse planning and land management

• Watershed management

• Water management planning

• Flood hazard assessment on local level

• Emergency planning and management

• Planning of technical measures

• Overall awareness building

2. Flood risk maps

• Basis for policy dialogue

• Priority setting for measures

• Flood Risk Management Strategy (prevention,

mitigation)

• Emergency management (e.g. the determination of

main assets)

• Overall awareness building

3. Emergency maps

• Emergency management

4. Insurance maps

• Insurance

The Handbook is available at: http://ec.europa.eu/

environment/water/flood\_risk/flood\_atlas/pdf/

handbook\_goodpractice.pdf

Victorian Flood Data and Mapping Guidelines

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Flood warnings for Geelong are linked to river

heights at Macintyre Bridge on the Barwon River.

Source: Simone Wilkinson, DELWP

Tide marker at Barwon Heads.

Source: Simone Wilkinson, DELWP

Part 2: Standardisation of flood

data collection

1. Introduction

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Step 1 – What is the value of data collection? Determining priority areas and trigger points for data collection 33

Step 2 – What could data be used for?

Step 3 – What data do you need for this purpose?

Step 4 – What is the most appropriate way to source the data?

Step 5 – Who is best to collect the data?

Step 6 – How will the data be documented and stored?

Victorian Flood Data and Mapping Guidelines

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Part 2

1.Introduction

One component of the Victorian Government’s response

to the 2011 Victorian Floods Review (the Comrie

Review) was a commitment to review processes and

arrangements for collection of data during and after a

flood.

The floods review found that roles and responsibilities

for flood data collection were unclear on the extent and

type of information that should be collected.

These guidelines promote a consistent approach to

the process of flood data collection in Victoria. They

encourage development of locally agreed processes for

collection of flood data sets that can be used for a range

of purposes.

Development of the guidelines involved several discrete

tasks, including:

• stakeholder engagement via a facilitated workshop

to determine what was needed in the guidelines, and

who uses flood data and why

• review of existing generic guidelines

• further engagement to obtain feedback on the revised

guidelines.

Flood depth marker at Russells Bridge. Source: Simone Wilkinson, DELWP

Victorian Flood Data and Mapping Guidelines

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Part 2

2.Background and context

2.1

Overview of the Victorian Floods

Review and Government response

The Comrie Review highlighted the need for consistent,

reliable data about floods:

Recommendation 29: “the state clarify which agency is

responsible for collecting post-flood extent and related

data. This should include:

• The development of guidelines to ensure consistent

standards are applied to post-flood data collection; and

• An appropriate process to ensure funding availability

for such activities.”

The Review noted the importance of regularly collecting

data after a flood to improve understanding of flood

behaviour for a range of purposes, including updating

flood plans, identifying gaps in flood warning systems,

and enhanced land use planning. The Review also

noted that data collection should include recording

not just flood extents and depths, but the time and

corresponding flood gauge height when infrastructure

such as roads, medical facilities and other essential

services are first flooded.

2.2

Approaches to flood

data collection

The Review noted that there was a significant data

collection effort, primarily by CMAs, following the 201011

floods. This included:

• community meetings, particularly in areas where little

information was previously available

• floor level surveys

• pegging of flood extents, both during and after the

events

• aerial photography, particularly to capture flood

extents.

However, during consultation for the Review, some Local

Government Authorities (LGAs) said they “were unsure

whether or not the CMAs would be collecting data in

urban centres”.

These guidelines update arrangements for coordination

and consistency of flood data collection to reflect

the expectations of the Victorian Floods Review. This

includes expanding the generic list of data types to be

collected and associated responsibilities for collection.

The roles of each agency in collection of data need to be

agreed, documented and understood to avoid confusion

and wasted time and resources when a flood occurs.

2.2.1

Victoria Flood Management Strategy 1998

The Victoria Flood Management Strategy (1998) stated

that Department of Natural Resources and Environment

(DNRE), CMAs and Councils would undertake

“monitoring of flood events”. Comrie noted that while

CMAs typically “coordinate the monitoring of significant

flood events”, there was still considerable uncertainty

about responsibility for collection of data post the

2010-11 floods. He stated that “it is not unreasonable to

expect that Councils would collect data specific to urban

systems and CMAs and DSE rural areas.”

Victorian Flood Data and Mapping Guidelines

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Part 2

2.2.2

Catchment Management Authority

Water Act 1989 Statement of Obligations

The Catchment Management Authority Water Act

Statement of Obligations clause 28 subclause 5 says:

“The Authority shall coordinate the collection of

appropriate flood data following a significant flood

event and make it available to the public”. The Victorian

Government’s response to the Victorian Floods Review

Recommendation 29 said the statement of obligations

would “be reviewed to recognise the importance of

collecting flood data”.

2.2.3

Department of Sustainability and

Environment flood response guidelines –

July 2008

The DSE 2008 flood response guidelines summarised

roles and responsibilities for collection of flood data, as

well as describing the main types of data to be collected.

The guidelines set out CMA and DSE responsibilities,

including cost sharing and triggers for data collection.

The Victorian government’s response to the floods

review Recommendation 29 says that these procedures

will be reviewed to ensure they include “clearer

protocols and standards.”

2.2.4

CMA flood response action plan

The generic CMA flood response action plan includes

appended flood data collection guidelines that generally

reflect the 2008 DSE guidelines.

2.2.5

Victorian Floodplain Management

Strategy

The 2016 Victorian Floodplain Management Strategy

notes that CMAs and Melbourne Water will continue

to be accountable for identifying and prioritising post-

flood data needs, in collaboration with DELWP. These

guidelines have been developed to encourage consistent

standards for post-flood data collection.

Recreational open spaces on the Murray River floodplain at Mildura. Source: Simone Wilkinson, DELWP

Victorian Flood Data and Mapping Guidelines

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Part 2

3.Business requirements for flood data collection

3.1 Business needs and key

stakeholders

Flood data collected during and after a flood from a

variety of sources provides valuable information on

flood behaviour. Records of flood flow, flood depth,

flood extent and flood behaviour are important for

calibrating and validating computer models. The types

of desirable flood data sets are provided in Chapter 4

to guide development of CMA flood data collection

arrangements.

The business needs associated with flood behaviour

mapping projects are included in Part 1 of this

document, Victorian Guidelines for Standardisation of

Flood Mapping.

Some of the more significant data types collected, and

their uses, include:

•

Peak flood levels; peak flood flows; peak flood

extents: This will provide calibration data for

hydrologic and hydraulic models, leading to

improved estimates of flood levels and extents

for a range of AEP floods. This will, in turn,

improve planning schemes, improve land use and

development planning, and improve assessment of

flood risk in determining insurance premiums.

•

Inundated properties; roads and rail lines closed or

damaged: This will provide input to assessments

of flood consequences for a range of AEPs, and

improve planning for those events.

•

Performance of levees and other flood mitigation

works: This will provide data for design of upgrades

to mitigation works that did not perform as

expected.

Table 1 provides a more complete tabulation of flood

data that could be collected, uses of the data and the

benefits associated with its collection.

Crops planted on the Moorabool River floodplain. Source: Simone Wilkinson, DELWP

Victorian Flood Data and Mapping Guidelines

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Part 2

Table 1: Data types, sources, uses and benefits

2. What

could data

be used for?

3. What data do you need for this purpose?

4. What is

the most

appropriate way

to source data?

5. Who is

best to collect

the data?

Land use planning, development assessment

Data type Sub-type Description details

Improved

land use

planning

Recalibration

of models –

revised flood

levels

Rainfall

Distribution, totals

over period, temporal

distribution

Rainfall networks BoM, Rural Water

Authorities x

Recalibration

of hydrologic

models –

revised flood

levels

Peak flood

flows, shapes of

hydrographs, travel

times

Stream gauging

records

Records from permanent

stream gauging stations and

field measurements of flow

/ height relationships

Stream gauge

sites and Thiess

Hydrographic

Services Pty Ltd

DEWLP, Rural Water

Authorities, BoM

x

Reservoir

performance

Reservoir inflows and

outflows Reservoir operators DEWLP, MDBA, Rural

Water Authorities

Recalibration

of models –

revised flood

levels

Peak flood levels River gauge levels and flood

marks (waterline or debris)

Stream gauge

sites (including via

Portable Automated

Logger Systems

(PALS)) and field

survey contractors

Municipalities, CMAs x

Recalibration

of models –

revised flood

extents

Peak flood extents

Aerial flood

photography

Vertical and oblique flood

photography, as close to

peak as possible, natural or

infra-red

Contractors

Municipalities,

Government

Agencies (e.g.

VicRoads), media.

xSatellite imagery Remote sensing

specialist retailers

Municipalities, Rural

Water Authorities

Ground-based flood

photography

Photographs of flood extent

and impacts, taken at

ground level

Field staff, local

residents

Municipalities, Rural

Water Authorities

Assessment of

performance

of works and

infrastructure

relative to

performance

standards

Evaluation of asset

performance

Performance of

levees, seawalls,

retarding

basins, bridges,

culverts, drainage

infrastructure, etc

Photographs, description

of performance,

description of damage,

percentage of flow

capacity blocked

Asset owners and

managers CMAs, municipalities x

Victorian Flood Data and Mapping Guidelines

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Part 2

1. What is the value of data collection?

Emergency planning and response Flood mitigation Property

flood risk

Improved

development

application

assessment

Improved

emergency

planning

Improved

emergency

response

Improved

flood

mitigation

design

Flood

mitigation

work

upgrades

Improved

access

to flood

mitigation

funding

Improved

waterway

asset

protection

Improved

Civil

Infrast’ure

Protection

Improved

Flood Risk

Assessment

(Insurance)

x x x x x x

x x x x x x

x x x x x x

x x x x x x

x x x x x x

Victorian Flood Data and Mapping Guidelines

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Part 2

Table 1: Data Types, Sources, Uses and Benefits (continued)

2. What

could data

be used for?

3. What data do you need for this purpose?

4. What is

the most

appropriate way

to source data?

5. Who is

best to collect

the data?

Land use planning, development assessment

Data type Sub-type Description details

Improved

land use

planning

Assessment

of total flood

damage costs

Assessment

of consistency

with

emergency

management

planning

Assessment

of adequacy

of land use

planning

Assessment

of consistency

with and

adequacy of

emergency

management

planning

Assessment

of adequacy

of evacuation

centres,

evacuation

routes

Flood damages

Flood warning

and emergency

management

activities

Deaths/injuries

Erosion/debris damage

(waterways, bridges,

levees, etc)

Which buildings and

properties were Field staff, local Municipalities,

inundated and to what residents insurance companies

depth

Which roads/rail lines/

infrastructure closed/

damaged

Asset owners,

managers Municipalities

Direct and indirect overall

damage costs

Flood relief payments

Sequence of flood

inundation

Numbers of people

evacuated; from/to

where. Issues?

Warning times

Performance of

emergency services

Photos of flood

extent and impacts,

taken at ground

level

Grants and disaster

relief payments,

insurance

payments, Red

Cross, Salvation

Army

Victoria Police

Field staff

Those involved in

flood response

and recovery,

flood situation

reports. Flood

questionnaires

Beneficiaries and

those providing

funding

Field staff, local

residents

Victoria Police,

municipalities

Local residents

Vic SES

VICSES

CMAs, municipalities

Dept. Treasury

and Finance,

Municipalities,

DEWLP, BoM, VFF,

community, Dept.

Human Services,

insurance companies

Dept. Treasury

and Finance, Dept.

Human Services,

other agencies

CMAs, municipalities

VICSES

VICSES, CMAs, BoM

Municipalities,

Victoria Police

x

Victorian Flood Data and Mapping Guidelines

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Part 2

1. What is the value of data collection?

Emergency planning and response Flood mitigation Property

flood risk

Improved

development

application

assessment

Improved

emergency

planning

Improved

emergency

response

Improved

flood

mitigation

design

Flood

mitigation

work

upgrades

Improved

access

to flood

mitigation

funding

Improved

waterway

asset

protection

Improved

Civil

Infrast’ure

Protection

Improved

Flood Risk

Assessment

(Insurance)

x x x x x x x x x

x x x x x

Victorian Flood Data and Mapping Guidelines

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Part 2

4.Planning for flood data collection

To minimise the uncertainties in flood data collection

identified in the Comrie review, floodplain managers

need to plan and document activities well in advance of

a flood.

There are context-specific considerations that need to

be taken into account in planning these activities, so

these guidelines do not give a prescriptive process for

planning flood data collection. Instead, the following

provides a series of key questions to be considered and a

generic process for determining what activities should be

planned. These include:

• Why should we collect the data?

• How will it be used?

• What data needs to be collected?

• What methods should be used for collecting data?

• Who should collect the data?

The following sections provide further information about

these key elements, including a summary table to inform

flood data collection planning and conversations with

other agencies and partner organisations.

The scope and nature of flood data collection should be

considered for different flood scenarios by following the

six step process:

1.Whatisthevalueofdatacollection?

•e.g.understandfloodbehaviourinpoorlyunderstoodareas,ornewdevelopmentareas2.Whatcoulddatabeusedfor?

•e.g.recalibrationoffloodmodelstorevisefloodlevelsinkeyareasofcatchment3.Whatdatadoyouneedforthispurpose?

•e.g.peakfloodextents4.Whatisthemostappropriatewaytosourcethedata?

•e.g.aerialphotography•e.g.surveyofdebrislevel5.Whoisbesttocollectthedata?

•e.g.aerialphotographycontractors•e.g.localstakeholder/agencies6.Howwillthedatabedocumentedandstored?

•e.g.VictoriaFloodDatabase

Victorian Flood Data and Mapping Guidelines

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Part 2

Step 1 – What is the value of data

collection? Determining priority areas

and trigger points for data collection

Flood data collection can be a costly exercise so it is

important that resources be appropriately prioritised

and targeted. To maximise the effectiveness of data

collection, all CMAs, Melbourne Water, councils and

other relevant agencies should have clear plans in place,

with accompanying maps documenting target areas,

trigger points and relative priorities. Trigger points

should, where possible, be linked to flood warnings and

associated flood gauge levels.

To determine target areas and priorities, take into

account:

• The magnitude of the flood event. Additional effort

will particularly be warranted if the event is the largest

on record.

• Information gaps, particularly if these are in areas of

significant development or known flood risk.

• Types of data gaps. Some types of data are most

effectively collected during or as soon as possible

after a flood. Gauging of peak flood flows and aerial

photography of peak flood extents, for example, must

be undertaken as close to the time of the flood peak as

possible. The clarity of debris marks and other similar

evidence of peak flood levels diminish rapidly after a

flood and should be recorded as soon as possible after

the flood recedes.

Step 2 – What could data be used for?

Table 1 provides a summary of the types of data that

could be collected, uses for the collected data, collection

methods and key resources.

The key uses for data summarised in the table include:

• recalibration and validation of hydraulic models –

revised flood levels and extents

• recalibration of hydrologic models – revised flows

• assessment of performance of levees and other flood

mitigation works relative to performance standards

• assessment of total flood damage costs

• assessment of consistency with and adequacy of

emergency management planning

• assessment of adequacy of land use planning

• assessment of adequacy of evacuation centres and

evacuation routes.

Victorian Flood Data and Mapping Guidelines

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Part 2

Step 3 – What data do you need for Peak flood level surveys

this purpose?

Types of data collection

Table 1 documents the various types of data that could

be collected, based on a range of business needs. It is

important that agencies agree on these needs well in

advance of a flood.

Rainfall

Rainfall records help monitor and assess floods, and

are useful for future flood studies. Rainfall distribution

patterns, intensities and totals falling over the catchment

are inputs for hydrological modelling. This information

is available from BoM, Regional Water Monitoring

Partnerships and Melbourne Water.

Peak flood flows

Peak flood flows and hydrographs are available

from stream gauging stations (if they have a rating

table). Alternatively, hydrographers can undertake

measurements during floods. The information is useful

to determine flow magnitude and flood frequency.

Floods provide an opportunity to undertake additional

gaugings to improve the gauge height versus flow

correlations that form the basis of flow rating tables.

Planning is essential for field measurement during a

flood and this can be arranged through the relevant

Regional Water Monitoring Partnership. CMAs should

check with the partnership coordinator to understand

arrangements in their area. Alternatively, each CMA may

establish a standing contract with hydrographers that

includes provisions for call-out at short notice.

Concentrate on areas where there is a shortage of flow

information and also where there is a need to improve

rating tables at river gauges. In some instances, CMAs

may also want to arrange peak flow measurements at

specific ungauged sites, e.g. if there is a need to clarify

flow distributions across a floodplain.

Flood level surveys are best undertaken soon after a

flood, when multiple recent flood marks are available,

pegs haven’t been disturbed and people’s memories are

fresh. Apart from the basic requirements of a licensed

surveyor (preferably with experience in surveying flood

marks) the following is required:

Interviews

• Procedures to ensure a reasonable effort is expended

in contacting landholders.

• Interviews with landholders about the current and

previous flood heights.

• Contact landholders prior to levelling.

Flood marking

• Flood marks should be captured on both sides of

the floodplain and, if possible, spread out across the

floodplain.

• Levels should be obtained at the locations of previous

recorded flood levels if possible.

• Flood levels should be distributed at reasonable

intervals along the floodplain (this can be every

hundred metres to every 2,000 metres, depending on

the hydraulic slope).

• Levelling to AHD +/-5 cm (if GPS is used, need accuracy

checks).

• Return runs as a cross check for accuracy.

Documentation

• A robust method of documentation (consider use of

laptops, spreadsheets, scanned imagery for locating

and recording flood mark locations and GIS capability).

• A standard form of documentation so that all flood

level surveys are consistent.

• Placing survey marks at a permanent fixture.

• Field sketches and photographs.

• Distance of flood marks to fences, roads or other

features (for later plotting and establishment of

coordinates or if Global Positioning System [GPS] is

used, as a sanity check).

• Use of suitable reference maps (hard copies and/or

digital).

• Locations of flood marks in AMG coordinates.

• GIS capability – peak flood levels should be collected

in a format that enables them to be uploaded to the

Victoria Flood Database (VFD).

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Part 2

Project controls

• For large jobs, divide into areas under different survey

teams, coordinated by a central project manager who

must ensure that there is a reasonable coverage of

levels.

• If GPS is used for establishing flood levels, document

corrections made and provide cross checks with bench

marks.

• Record methodology.

• Provide consistent documentation and presentation.

• Flood level surveys are usually undertaken by licensed

surveyors.

Portable data loggers (Portable Automated Loggers

[PALS]) are available for deployment to collect and

transmit flood level data during a flood event.

Flood pegging

Flood pegging involves placing stakes in the ground,

preferably close to the peak and within the area

predicted to be affected by flooding. When the flood

recedes watermarks are left on the pegs (particularly if

they are coated with water-soluble paint).

Flood pegging is commonly employed for slow-moving

floods, where there is little turbulence, a reasonable

amount of flood warning time and site conditions are not

likely to be hazardous. Stakes should be located where

they are unlikely to be affected by debris, typically at

the edge of the flood, and where they are unlikely to be

disturbed.

As a supplement or alternative to recording a level on

a stake, a record of peak flood levels can be taken by

observing the results of flood debris. Fine debris, in the

form of grass seed, saw dust, discolouration (resulting

from turbid floodwaters) or small leaves, provides the

best record and is often found above coarser flood

debris (grass, paper, plastic, rubbish, tree trunks, etc).

It is usually deposited from receding floodwaters and is

strained out when passing through fence posts, bushes,

trees, etc. Flood marks in vegetation may overestimate

the flood levels if the vegetation resumes its upright

position after a flood or if wave action occurs.

Each stake (or mark) needs to be identified (given a

number). Usually, the level of the water on the stake is

marked by chalk, crayon, paint or waterproof ink close

to the flood peak. The date and time of the observation

should be recorded.

Equipment needs are basic and include:

• survey stakes – purchased in advance, preferably

painted so they can be seen and stored

• CMA identification

• mobile phone

• camera

• locality map

• waterproof clothing, umbrella

• writing materials (paper and clipboard or writing pad,

pens, pencils)

• tape measure

• stakes, hammer and nails

• marker tape or fluorescent spray can

• adequate refreshments.

As many levels as possible should be marked during a

flood at chosen locations along the entire length of a

waterway. If possible, an adjacent flood mark should be

obtained as confirmation of the level and as a safeguard

if a stake is washed away. Flood level marking should

also be supported by landowner observations, where

possible.

Aerial flood photography

Aerial photography provides a historic record of the

extent of flooding at a given date and time. It provides

useful data to confirm areas flooded and to verify flood

behaviour.

The quality and the usefulness of the information will

depend on the available budget, the coverage and the

prevailing weather conditions. If flying conditions are

restricted because of bad weather or there are cost

issues, a hand-held camera (or video recorder) out of a

plane or helicopter might be the only realistic option.

CMAs should consider purchasing a digital camera, with

GPS receiver and GPS photo link software to make the

process of linking the photo with the location easier.

If weather conditions and budget permit, fully orthorectified

photography (i.e. photos corrected for camera

tilts and terrain distortions) is recommended.

For slow-moving floods across large floodplains, it

may be necessary to arrange flood photography over

a number of days, to ensure flood extents close to the

flood peak are captured.

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Part 2

General requirements are:

• Large format, metric colour photography is preferred.

• Civil Aviation Safety Authority (CASA) certified operator

with a specially mounted camera system.

• Vertical photography, supplemented by obliques if

cloud cover is a problem.

• Digital flight plan showing run and photo centres

provided in ESRI shape format.

• Description of flood (e.g. October 1993 floods – Broken

River), time of photography, altitude, date and photo

number to be clearly recorded on each photograph.

• Entire flood plain to be captured.

• Full stereo coverage (60% forward and 30% side

overlap).

• Indication of location and travel time of flood peak.

• Follow the flood peak (there’s no point in

photographing dry areas).

Flood photography needs to be arranged as quickly as

possible, in advance of the flood peak. The time taken

from the earliest reliable indication of major flooding to

the commencement of photography is typically around

24 hours (less if a locally based contractor is available).

If the flood peak is missed, infra-red photography may

provide a reasonable indication of wet and dry areas.

The scale of photography will vary and is generally

determined by the cloud cover. For 1:25,000 scale

photography, the flying height is about 4,000 m. For

1:5,000 scale, the flying height is about 770 m.

DELWP should be consulted regarding state-based

purchasing arrangements prior to seeking quotes.

Satellite photography

Satellite imagery can be a useful way to record the

extent of flooding for widespread regional floods,

particularly if there is plenty of warning time. However,

in most instances, aerial photography will provide better

resolution and greater flexibility.

Potential applications for satellite photography include:

• use as a supplement to flood photography to provide

an overview of flood behaviour at a coarser scale

• in lieu of flood photography where a high resolution is

not required (e.g. large-scale rural flooding with slow-

moving floodwaters in sparsely inhabited areas

• as a planning tool for flood response operations.

Earth observation and satellite imagery is available

through Geoscience Australia (GA), Australia’s major

public satellite remote sensing organisation. A link for

GA products is http://www.ga.gov.au/earth-observation.

html. Prices and outputs vary according to the spatial

resolution required, the amount of data processing

required, the output format and whether there are any

special requirements.

It is worth noting that:

• archived material can be purchased after a flood has

passed and is less expensive than specifically booked

imagery

• while there are a number of satellites to choose from,

they each serve different needs

• special requirements (e.g. high-resolution imagery

or cloud penetrating radar) will cost more, and it

will typically be necessary to give five days’ notice,

assuming the satellite of choice is in the right place at

the right time.

Evaluation of asset performance

Data collected during and after a flood can be used to

assess the effectiveness of levee banks, retarding basins

and other flood mitigation works in performing their

intended functions. This could include, for example:

• recording the locations of overtopping or failure of

levee banks, and flood levels at which failure occurred

• analysing the degree of retardation provided by a

retarding basin relative to design intent.

Flood damage assessments

Reliable flood damage figures are necessary for

evaluating the economic and social impact of the flood,

the effectiveness (or otherwise) of flood response

measures, and to provide a framework for economic and

social assessment of flood prevention activities.

Data is generally collected during or soon after the

flood; and while it should ideally be verified, this is not

always feasible. It is recommended that when a formal

flood report is produced to document and review the

flood, a reasonable attempt is made to collect flood

damage data and to assess flood damages, including

damage to waterways. Relevant information will include

which properties and buildings were inundated and to

what depth, and which roads, railway lines and other

infrastructure were damaged or suffered reduced

services. Relevant agencies should be approached and

any shortcomings in the available data followed up, if

possible.

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Part 2

Floor levels of buildings in flood-prone areas are useful

background data for flood damage assessments. A

floor level survey is often undertaken as part of a flood

study, and this data can be stored in the Victoria Flood

Database (VFD). CMAs and Local Government should

keep the VFD floor level database up to date.

Waterway damage assessment

During a major flood, waterways and associated assets

are often damaged. An assessment of river damage

should be carried out and all damage documented:

• Piles of debris accumulate along river banks and

the floodplain. During floods, these accumulations

can divert stream flows, erode river banks and

scour the river bed. If they are not removed, the

river environment and infrastructure can be further

damaged when the river floods again.

• Debris accumulation at in-stream structures such as

weirs and bridges with potential to cause structural

damage or even complete failure.

• Swiftly flowing water can erode river banks, especially

where native vegetation has been removed or stock

access has not been restricted. Erosion damage can

be magnified when accumulated debris diverts water

flows.

• Soil particles dislodged by swiftly flowing streams and

carried in suspension are deposited downstream in the

river bed or the adjacent floodplain. Sedimentation

within the river corridor can be a problem when it

diverts water flows, eroding banks and even diverting

the river itself.

• Fences are often damaged or destroyed as a result

of scouring, the sheer volume of the water and the

movement of flood debris. Many fences protect native

re-vegetation plantations and their repair is often a

high priority to contain and manage stock movements

and to ensure bankside vegetation does not get

unnecessarily damaged.

• Damage to works previously undertaken to manage

the river environment. Plantations that were designed

to restore river vegetation may be destroyed along

with their protective fencing, and structures designed

to divert or (re)align river flows may be affected.

• Avulsions/river breakaways with potential change

in river courses, affecting stream morphology, built

infrastructure and private land.

All documentation and records, including damage

assessments and photographs, should be stored for

future reference.

Flood warning and emergency management

activities

The effectiveness of emergency management activity

should be assessed following a flood. This assessment

should include:

• The effectiveness of flood warning and emergency

management planning. Key questions will include

whether or not warnings provided were consistent

with peak flood levels, peak inundation extents,

sequences of inundation, flood travel times, road

closures, and property inundation. Reasons for any

inconsistencies should be investigated, and plans

amended if required.

• Consistency of emergency planning and

implementation. Typical questions will include

whether roads were closed, properties evacuated,

and levees sandbagged as planned. Again, reasons for

any inconsistencies should be investigated, and plans

amended if required.

Campaspe River flood warning

gauge at Rochester. Source: John

McCartney, Shire of Campaspe

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Part 2

Step 4 – What is the most appropriate

way to source the data?

Step 3 includes significant discussion of the technical

issues to be considered in collection of peak flood flow

data, aerial and satellite photography, and peak flood

levels.

Collection of much of the data listed in Table 1 will

require consultation with agencies and landholders.

Comrie (2011) stressed the importance of capturing

and capitalising on local knowledge of flooding, and this

particularly applies to flood data collection. The Comrie

Report notes that, “Public meetings were held in regional

locations with the specific goal to obtain as much

information as possible relating to the January 2011 food

event, specifically in areas where little information was

previously available.”

Consultation to collect flood data should include:

• interviews with relevant agencies and other bodies

including municipalities, VicRoads, rail authorities,

rural water authorities and other utility agencies,

VICSES, Victoria Police and insurance companies

• public meetings

• personal discussion with affected landholders.

Step 5 – Who is best to collect the data?

While CMAs typically coordinate the monitoring

of significant flood events, there was considerable

uncertainty about responsibility for collection of data

after the 2010-11 floods.

The Comrie Report noted: “It is not unreasonable to

expect that Councils would collect data specific to urban

systems and CMAs and DSE in rural areas.”

While such a subdivision of responsibility should be

broadly adopted, it is important that CMAs coordinate

discussion between the relevant agencies to ensure clear

agreement on local arrangements well in advance of a

flood. This should be based on availability of resources

in the locations where they are likely to be required and

should include consideration of the locations of agency

offices. Clarity of arrangements is particularly important

for any data that must be collected during or as soon

as possible after a flood, such as gauging of peak flows,

aerial photography of peak flood extents, and recording

of peak flood levels.

Agreements on local data collection arrangements

should be documented.

CMAs should assume an overarching responsibility for

coordination of the collation of data listed in, with the

exception of data related to emergency management,

which should be overseen by VICSES. DELWP will monitor

and review how total flood warning services perform.

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Part 2

Step 6 – How will the data be

documented and stored?

It is likely that data collected during and after a flood will

initially be recorded in a range of different digital and

hard copy formats.

In addition to any local requirements for digital

formatting, all relevant digital outputs are expected to

be submitted for inclusion in the VFD. DELWP should

be consulted regarding current VFD specifications and

layers.

VFD requirements will include, in particular, peak flood

extents and levels.

Some of the data collected may also be relevant for

inclusion in documentation such as:

• Municipal Flood Emergency Plans (MFEPs). These

provide location-specific information on flood history,

the local flood regime and critical areas of high flood

risk.

• Community education products that are often

prepared to supplement flood mapping projects.

These may take the form of local flood guides that

provide key information on local flood history, the

flood mapping process, anecdotal information

from residents, and an overview of flood mitigation

measures.

A range of documents that use flood data. Source: DELWP

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Agriculture on the Moorabool River near Bateford.

Source: Simone Wilkinson, DELWP

Part 3: Consultation report

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3. Survey respondents 45

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Part 3

1. Introduction and summary

During the development of the draft guidelines for

standardisation of flood mapping, the project team

consulted with the local government sector through the

Municipal Association of Victoria (MAV).

A survey was developed and forwarded through MAV

to council representatives from planning, engineering

and emergency management departments to encourage

them to review the guidelines and complete the survey.

The survey link was distributed through MAV on 21

November 2013 and was open until 19 December 2013.

There were 86 responses from across rural areas (41%),

metropolitan Melbourne (34%) and regional cities (25%).

Responses were received from a range of roles including

(but not limited to) strategic land use planners and

planning officers, infrastructure managers, engineers,

emergency management coordinators and GIS officers.

This report provides a summary of the feedback

obtained from the survey, and the response from

the project team responsible for development of the

guidelines and a steering group of key stakeholders.

The key issues raised by the survey, and the project

team and steering group’s responses to those issues are

summarised in the table opposite.

One of the key messages is that the guidelines do not

impose additional requirements for local government

in the majority of instances. If local government does

undertake flood studies, the guidelines will provide a

key supporting resource. The steering group encourages

strong collaboration between local government, CMAs/

Melbourne Water and DELWP.

The consultation undertaken with a range of agencies,

including local government, during preparation of the

guidelines provided valuable feedback and input on a

diverse range of issues.

Floor levels constructed higher than the 1% AEP flood level. Source: Simone Wilkinson, DELWP

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Part 3

Key issue Project response

The importance of the guidelines in The guidelines aim to promote consistency in the scope of flood studies. They also

promoting consistency in the range of promote a best practice approach to mapping. They link with appropriate publications

outputs needed from flood studies to (e.g. Australian Rainfall and Runoff [ARR] that provide contemporary technical inputs

meet the maximum range of uses, or and link to latest thinking on technical issues.

business needs.

The importance of the guidelines for Several survey responses referred to the need to provide more specific guidance

land use planning and in linking flood regarding development of planning controls and overlays.

studies to planning schemes. While providing advice about developing planning scheme controls is beyond the scope

of the guidelines, a discussion has been inserted, with a link to the key relevant DELWP

planning practice note.

The potential cost and resourcing

implications of the guidelines for local

government.

The guidelines do not impose additional requirements for local government. Flood

studies and mapping should provide enhanced understanding, better decision making

and improved risk management

Based on the steering group’s understanding of contemporary practice, it is not

anticipated that the guidelines will significantly affect the current cost and resourcing

related to flood studies and mapping.

The guidelines also aim to provide additional practical support to those with less

experience of flood studies. Many local government areas lack resources and expertise

with respect to flood mapping, and the steering group encourages collaboration with

CMAs/Melbourne Water and DELWP. The accompanying post-flood data collection

guidelines are intended to promote greater collaboration and planning between

flooding partners prior to the occurrence of a flood.

The guidelines highlight the need for A key requirement of the Comrie review was to enhance the provision of information

communication with the community. to the community, and this requirement was also identified during interactions with

stakeholders in the development of the guidelines. Sharing of information with the

community is a key component of the Victorian Floodplain Management Strategy.

The extent of consultation undertaken Substantial input from stakeholders with various experience in flood studies

during preparation of the guidelines. and mapping assisted the development of the guidelines. This included DELWP,

CMAs, Melbourne Water and VICSES, so they encompass consistent collection of

information, and enhance usefulness of mapping products for emergency planning and

management.

The need for the guidelines to consider The guidelines promote a standardised approach to flood mapping in Victoria that is

other types of flooding, e.g. storm relevant whether the source of flooding is riverine, stormwater or coastal.

surge, and climate change. The primary mechanism for linking to climate change is through the referenced link to

Australian Rainfall and Runoff, which is currently under revision. It is understood that

this will include guidance on approaches to climate change.

The importance of guidance on map

presentation.

Detailed specification of map presentation and format was considered beyond the

scope of the project. However, guidance on map presentation is provided through links

with DTPLI’s Communicating Data with Colour guideline. Additionally, it is anticipated

that the Flood Intelligence Platform will further assist with standardising protocols and

presentation of planning information.

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Part 3

2. Survey overview

The purpose of the survey was to encourage local

government representatives to review the guidelines,

complete the survey and provide feedback on the project

team and steering group prior to finalisation of the

guidelines. The questions were targeted to understand

areas of key concern and to identify potential gaps and

opportunity for enhancement of the guidelines. The

questions asked were:

1.

Which of these options best describes where your

council is located?

– Rural Area

– Regional City

– Metropolitan Melbourne

2.

What are your most important business needs

that should be considered in the finalising of the

guidelines?

3.

What parts of the guidelines are of most relevance

to your organisation?

4.

What makes these parts more relevant than others?

5.

Do you have any general comments or feedback on

the guidelines? If so, please specify.

6.

Do you have comments about specific sections of

the report? If so, please specify and note the section

each comment relates to (e.g. section 3.3 para 2).

7.

Is there anything else that should be included in

guidelines?

8.

Please indicate which of the following statements

best reflects current practices within your

jurisdiction.

– Current practices will be sufficient to meet the

requirements of the guidelines

– Current practices will meet most of the requirements

of the guidelines.

– Current practices will meet some of the

requirements of the guidelines.

– Current practices will not meet any of the

requirements of the guidelines.

– I don’t when whether current practices will meet the

requirements of the guidelines.

9.

What is the name of your organisation? (Optional)

10. What is your position? (Optional)

11. In case we need to follow up any of your responses,

please provide your name. (Optional)

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Part 3

3. Survey respondents

Locations and roles (Question 1)

Respondents were asked to indicate whether they are working for a rural, regional or metropolitan council. The 85

responses to this question show that all three categories were represented.

41%

34%

25%

0%

5%

10%

15%

20%

25%

30%

35%

40%

45%

RuralMetropolitanMelbourneRegionalCity

Respondents were also given the option to note their work role or role title. The following table shows the various

roles of survey respondents:

Planning Engineering services Emergency management Mapping/GIS

Coordinator Strategic Land Use

Planning

Planning & Environment Officer

Planning Manager

Planning Officers

Planning Scheme

Implementation Team,

Senior Strategic Land Use

Planner

Statutory Planning Department

Strategic Planner

Strategic Planning Co-ordinator

Strategic Planning Officer

Strategic Projects Planner

Director Engineering &

Infrastructure

Director Infrastructure

Director Infrastructure Services

Drainage Engineer

Head of Stormwater Engineers

Infrastructure Planning Engineer

Manager Infrastructure Assets

Project Engineer

Manager Infrastructure Services

Manager, Assets and Properties

Emergency Coordinator

Emergency Management

Coordinator”

Emergency Management

Officers

Municipal Emergency

Resource Officers (MERO)

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Part 3

4. Survey responses

Question 2. What are your most important business needs that should be considered

in the finalising of the guidelines?

Respondents listed 78 ‘important needs’ in response to question 2, and this feedback was grouped into six key themes.

The most commonly cited ‘most important needs’ were:

• design of flood mapping projects including minimum requirements for outputs

• converting mapping outputs into planning instruments

• flood impact mitigation including emergency planning and response.

281813874StudyscopeandoutputsLanduseplanningFloodmitigationCommunityeducationResourcingDatamaintenance

Victorian Flood Data and Mapping Guidelines

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Project responses to feedback on Question 2:

Feedback Project response

Consistent study scope

and outputs

The guidelines aim to promote consistency in the scope of flood studies, i.e. to always map multiple

exceedance probability events (including the Probable Maximum Flood [PMF] if appropriate), link flood

extents to gauges where possible, identify consequences of flooding and consult with the community to

verify mapped extents.

The guidelines also promote a best practice approach to mapping. Where practical, they include core

key features, but could not include all background features that stakeholders wanted, as users need

different information to meet their business needs.

The guidelines link with appropriate publications (e.g. Australian Rainfall and Runoff) that provide

contemporary technical inputs and link to latest thinking on technical issues, including climate change

provisions.

Land use planning and Several comments pertained to the need to provide more specific guidance on development of planning

planning scheme controls and overlays.

While providing details about developing planning scheme controls is beyond the scope of the

guidelines, some discussion has been inserted. A link to DELWP planning Practice Note 12 (Applying the

Flood Provisions in Planning Schemes) has also been included.

Flood impact This theme includes comments about information to support flood mitigation and emergency planning

mitigation, emergency and planning for infrastructure improvements, including drainage and flood mitigation works.

planning and response VICSES (a Steering Group member) was consulted for advice to make sure the guidelines encompass

consistent collection of information and useful mapping products for emergency planning and

management.

Community

engagement and

education

A discussion is included about the need for maps to be easily interpreted and translated into community

information.

Resourcing required Feedback from stakeholders indicated that the guidelines represent an appropriate standard and

to implement the the approach is already being implemented by flood study proponents. The communication and

guidelines documentation of these guidelines will promote improving consistency in mapping. The guidelines are

not expected to represent a significant change in terms of resources required for undertaking flood

studies. One-third of survey respondents believed current practice was sufficient to meet most or all of

the guidelines’ requirements.

Data review, update This group of comments contained responses about timing for updates of flood mapping and

and maintenance accountability for keeping mapping current. The guidelines discuss potential triggers for revision of flood

mapping, and the Victorian Floodplain Management Strategy provides additional guidance on roles and

responsibilities with regard to flood mapping.

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Part 3

Question 3: What parts of the guidelines are of most relevance to your organisation?

This question received 37 responses. The parts of the guidelines considered of most relevance were grouped into six

themes. Typical business requirements and the elements of a project specification were areas highlighted as being of

most relevance to local government.

17

7

55

11

Business

requirements

Specifications

for

floodstudy

briefs

Guidelines

on

mappresentation

The

entire

document

Not

relevant

Guidelines

for

review

Project responses to feedback on Question 3:

Feedback Project response

Business requirements These responses indicated that the business requirements of flood mapping studies were of high

relevance to survey respondents. The practical application of flood studies and maps to meet business

needs is covered in the guidelines.

Example specification

for flood study briefs.

Guidance for scoping a flood study is understood to be of relevance and importance. The guidelines

link to the National Generic Brief for Flood Investigations developed by the National Flood Risk

Advisory Group. The National Flood Risk Advisory Group (NFRAG) has developed a National Generic

Brief for Flood Investigations (July 2014), and a Guideline for using the National Generic Brief for

Flood Investigations to Develop Project Specific Specifications (June 2014). These documents include

guidance on desirable flood study outputs. Victorian project managers are encouraged to use these

documents when planning their own flood studies

The entire document A number of people identified the document as being relevant and useful for their business needs.

Guidelines on map

presentation

Presentation of flood information has been an important theme through the consultation on the

guidelines. Additional guidance on presentation of maps is provide through the DTPLI document,

Communicating with Colour: http://www.dpcd.vic.gov.au/planning/publicationsandresearch/codesand-

guidelines/communicating-data-with-colour

Further standardisation of presentation is expected through the development of the flood information

platform: http://www.delwp.vic.gov.au/water/flood-warning-improvements

Guidelines for review of

flood mapping

The guidelines discuss potential triggers for revision of flood mapping, and the Victorian Floodplain

Management Strategy provides additional guidance on roles and responsibilities with regard to flood

mapping

Not Relevant Some respondents indicated that the guidelines were not relevant to councils, that flood mapping is all

complete in their municipality and that the guidelines are generic and set broad goals.

The steering group indicated that the guidelines are useful to many users, and that it would be difficult

to pitch them according to the wants and needs of all users. Changes to the document have made the

guidelines more relevant and useful for ongoing use for council staff involved in flood studies.

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Part 3

Question 4: What makes these parts more relevant than others?

Participants listed 32 responses to this question. The reasons given for describing particular areas as most relevant to

local government fell into four categories:

• providing guidance on project design, and mapping and other outputs from a flood study

• improving decision making and managing risk

• implications of cost of implementation

• communication with the local community.

16944DecisionmakingandmanagingriskProjectoutputsanddesignCostimplicationsforlocalgovernmentCommunicationandthelocalcommunity

Project responses to feedback on Question 4:

Feedback Project response

They are about improved

decision making and

managing risk

The guidelines show how to enhance the value of a flood study for a range of users and decision

makers including councils, CMAs, emergency services and the community.

They guide project design

and outputs

This is an important business need identified in Question 2.

They have cost implications

for local government

One of the aims of the guidelines was to provide additional value for flood studies undertaken and

improve the derived products (including maps). Based on the steering group’s understanding of

contemporary practice, it is not anticipated that this will significantly affect cost and resourcing.

They highlight

communication with the

community.

A key requirement of the Comrie review was to enhance the provision of information to the

community, and this requirement was also identified during interactions with stakeholders in the

development of the guidelines. Sharing of information with the community is a key component of

the Victorian Floodplain Management Strategy.

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Part 3

Question 5: Do you have any general comments or feedback on the guidelines?

Respondents listed 41 general comments in response to this question. Areas covered included suggestions for improved

or expanded sections, comments about practical guidance for developing flood mapping practices, and where the

guidelines are already in line with current practice.

1613642SuggestionsforimprovementTheguidelinesprovidepracticalguidanceforfloodstudiesOtherformsoffloodingandclimatechangeResourcingandcostsforlocalgovernmentTheguidelinesmaynotbeuseful

Victorian Flood Data and Mapping Guidelines

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Part 3

Project responses to feedback on Question 5:

Feedback Project response

The guidelines provide

practical guidance or are in line

with current best practice

The guidelines could be The guidelines promote a standardised approach to flood mapping in Victoria that is relevant

expanded to deal with other whether the source of flooding is riverine, stormwater or coastal the guidelines are relevant

flooding and climate change to other types of flooding. The primary mechanism for linking to climate change is through

Australian Rainfall and Runoff. The next ARR edition is expected to include guidance on

approaches to climate change.

Resourcing and cost The guidelines are not expected to significantly affect the current cost and resourcing related to

implications for local flood studies and mapping. The guidelines aim to provide additional practical support for those

government needs to be with less knowledge or experience of flood studies. Where local government lacks expertise

acknowledged and resources with respect to flood mapping the steering group encourages collaboration with

CMAs/Melbourne Water and DELWP. The separate post-flood data collection guidelines are

also intended to facilitate greater collaboration and planning between flooding partners prior to

the occurrence of a flood.

The guidelines may not be The guidelines are for any agencies that undertake flood studies, including local government,

useful – mapping is complete Melbourne Water and Catchment Management Authorities.

or it is not local government’s

role

Suggestions for improvement including inclusion of additional material, data management and presentation

Standardisation of Detailed specification of presentation and format was considered beyond the scope of the

presentation / format project. However, guidance on map presentation is provided through links with DTPLI’s

‘Communicating Data with Colour’ guideline. The flood intelligence platform is also expected to

assist with standardising protocols and presentation of planning information.

Guidance on including

consequences of flooding

Recommended project outputs include a flood damage assessment and input to Municipal

Flood Emergency Plans, which would include consequences to infrastructure and people

movement.

Implementation of the

guidelines

The Victorian Floodplain Management Strategy provides guidance regarding roles and

responsibilities for flood studies and managing flood information. The steering group

encourages local government to draw on the skills and resources of floodplain management

partners including CMAs/ Melbourne Water and VICSES, and encourages participation

in collaboration processes such as the development of Flood Emergency Plans and Flood

Management Plans (in the Metropolitan area).

Linking flood studies to DELWP provides a range of Planning Practice notes to assist with operation of the Victoria

planning controls Planning Provisions (VPP) and planning schemes as well as a range of planning processes

and topics. Reference to Planning Practice Note 12 (PPN12: Applying the Flood Provisions in

Planning Schemes) has been included in the guidelines to provide guidance about applying the

flood provisions in planning schemes.

Data collection / use • Agencies carrying out self-funded flood mapping exercises will be encouraged to follow the

DELWP guidelines.

• Agencies receiving government funding to support flood mapping will advise DELWP when

the mapping is complete and provide a copy for inclusion in the Victorian Flood Database.

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Part 3

Question 6: Do you have comments about specific sections of the report?

Question 6 provided respondents with the chance to provide more targeted comments on parts of the guidelines

that interest them. Seventeen comments, covering six main themes were received, however two important areas

dominated:

• comments about providing examples of project outputs or a generic project specification

• comments about the practical implications for local government relating to cost, resources and legal liability.

Areas of specific interest highlighted in feedback on Question 6:

652211Projectspecificationsandoutputs.

Cost,resourcesandlegalliabilityDatamanagementandformatsSuggestededitsTheguidelinesdonotprovideusefulguidanceAvailabilityofdata

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Part 3

Question 7: Is there anything else that should be included in the guidelines?

The dominant theme emerging from the 25 responses received to this question related to requests for guidance on

designing a flood mapping project, and examples of the standard that outputs should meet.

1144321024681012ProjectoutputsdesignUsingtheguidelinesindifferentcontextsAdministrativearrangementsTranslatingfloodmapsintoplanningschemesStayingcurrentandsharingexperiencesDatamanagementandformats

Project response to feedback on Question 7

Feedback Project response

Provide examples of preferred

outputs and how a project

should be designed

Victorian project managers are encouraged to use National Generic Brief for Flood

Investigations developed by the National Flood Risk Advisory Group when planning their own

flood studies. Examples of what flood study outputs are needed and what they are used for

have been added.

Administrative arrangements

for the guidelines

The guidelines are linked to the Victorian Floodplain Management Strategy.

Guidance on translating flood

maps into planning instruments

DELWP provides a range of Planning Practice notes to assist with operation of the Victoria

Planning Provisions (VPP) and planning schemes as well as a range of planning processes

and topics. In particular, reference to Planning Practice Note 12 (PPN12: Applying the Flood

Provisions in Planning Schemes) has been included in the guidelines to provide guidance

regarding applying the flood provisions in planning schemes.

Keeping the guidelines current

and sharing experiences

The steering group endorses the sharing of information, practices and examples through the

floodplain managers’ forum and collaboration between local government and floodplain

managers. Preparation of regional floodplain management strategies will help form contacts

and partnerships.

Data management and data

formats.

As outlined in the Victorian Floodplain Management Strategy, all agencies carrying out self-

generated flood mapping exercises will be encouraged to follow the DELWP guidelines. On

completion of such maps, councils will advise DELWP and provide a copy of the mapping for

inclusion in the Victorian Flood Database. Agencies carrying out flood mapping projects with

government funding will be required to follow these guidelines.

Victorian Flood Data and Mapping Guidelines

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Part 3

Question 8: Please indicate which of the following statements best reflects current

practices within your jurisdiction

In order to understand how the guidelines relate to scope of current practice, survey participants were asked to indicate

which statement reflected current practice. Thirty-three respondents answered Question 8.

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Project

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Administrativearrangements

Translating

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planningschemes

Staying

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andsharing

experiences

Data

managementand

formats

Comparison of the guidelines to current practice

Twenty-four respondents believed their current practices meet at least some of the requirements of the guidelines, with

three says their current practices will meet all the requirements. No respondents thought their current practices would

not meet any of the guideline’s requirements; seven were not sure or did not know.

The guidelines were developed in response to Comrie recommendation 21 to improve consistencies in flood mapping

across Victoria. Feedback from the steering group on the guidelines indicated that although the guidelines would help

to deliver consistency through documenting and sharing current practice, it was not expected to require significant

additional resources over that required for current flood mapping activities.

Victorian Flood Data and Mapping Guidelines

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Flood terminology

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% (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 floods of a given size or larger than a 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 (DFE)

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. It may include erecting a building or carrying

out 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.

Victorian Flood Data and Mapping Guidelines

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Flood terminology

Greenfield development refers to building in a currently

undeveloped area or development that is unrestrained by

prior work.

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

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. Minor roads may be

closed and low-level bridges submerged. In urban areas

inundation may affect some backyards and buildings

below the floor level as well as bicycle and pedestrian

paths. In rural areas removal of stock and equipment may

be required.

Moderate flooding: In addition to the above, the area of

inundation is more substantial. Main traffic routes may be

affected. Some buildings may be affected above the floor

level. Evacuation of flood-affected areas may be required.

In rural areas removal of stock is required.

Major flooding: In addition to the above, extensive rural

areas and/or urban areas are inundated. Many buildings

may be affected above the floor level. Properties and

towns are likely to be isolated and major rail and traffic

routes closed. Evacuation of flood-affected areas may be

required. Utility services may be impacted.

Flood 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 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

Victorian Flood Data and Mapping Guidelines

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Flood terminology

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 assessment 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.

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, megalitres per day (ML/day) or cubic

metres per second (m3/sec). 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 LGAs.

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, Average

Recurrence Interval, likelihood and probability).

Hazard

A source of potential harm or a situation with a potential

to cause loss.

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 (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 nonstructural)

taken in advance of a flood aimed at reducing

its impacts.

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Flood terminology

Municipal Flood Emergency 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

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 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 dice 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. Risk analysis in term of flooding is a

combination of defining what threat exists (see flood risk)

and what steps are taken (see risk management) (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 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).

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.

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Acronyms

AAD Average Annual Damage

AEP Annual Exceedance Probability

ARI Average Recurrence Interval

ARR Australian Rainfall and Runoff

BCA Building Code of Australia

BoM Bureau of Meteorology

CMA Catchment Management Authority

DELWP Department of Environment, Land, Water and Planning

DFE Design flood event

LGA Local Government Authority

LPPF Local Planning Policy Framework

MFEP Municipal Flood Emergency Plan

SPPF State Planning Policy Framework

TFWS Total Flood Warning System

VCS Victorian Coastal Strategy

VFD Victorian Flood Database

VFMS Victorian Floodplain Management Strategy

VICSES Victoria State Emergency Service

VPP Victoria Planning Provisions

WMS Water Management Scheme

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