

Guidelines for Development in Flood Affected Areas

February 2019



Acknowledgements

These guidelines have been prepared in consultation with floodplain managers from the nine regional Catchment Management Authorities, Melbourne Water and representatives from 22 local councils. The department gratefully acknowledges the advice received.

Please contact the floodplain manager of your local Catchment Management Authority or Melbourne Water for more information on how these guidelines are applied.

Corangamite CMA, www.ccma.vic.gov.au

East Gippsland CMA, www.egcma.com.au

Glenelg Hopkins CMA, www.ghcma.vic.gov.au

Goulbourn Broken CMA, www.gbcma.vic.gov.au

Mallee CMA, www.malleecma.vic.gov.au

Melbourne Water, www.melbournewater.com.au

North Central CMA, www.nccma.vic.gov.au

North East CMA, www.necma.vic.gov.au

West Gippsland CMA, www.wgcma.vic.gov.au

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Printed by Department of Environment, Land, Water and Planning

ISBN 978-1-76077-408-0 (pdf/online/MS word)

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Part One - Introduction

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1. Introduction

These guidelines provide an assessment framework and method to assist decisions on development in flood affected areas. In principle, development should not intensify the harmful impacts of flooding.

The purpose of the guidelines is to provide a clear, consistent and transparent process for managing land use and development in flood affected areas in Victoria. They are intended to be used with the land use planning and development system. Usually the information in the guidelines is sufficient to guide decision making. However, the guidelines cannot cover all the circumstances and aspects of flood behaviour.

Development includes the construction, alteration or demolition of a building or works and the subdivision or consolidation of land.

Floodplain managers have discretion to vary from the guidelines, considering local circumstances, the nature of the development proposal and the flood risk.

As can be seen in subsequent chapters, assessment of flood risk requires technical skills and knowledge of flood behaviour. Floodplain managers have these attributes, and are required to work with council staff, who are involved in the administration of planning permit applications and in undertaking planning scheme amendments. The two systems must work together.

Structure of these guidelines

For convenience, these guidelines comprise three parts.

Part One introduces the guidelines, plus basic information on flood risk management and climate change.

Part Two contains information on the regulatory framework used in decision-making. It examines key legislation and the roles and responsibilities of the key agencies that are affected by the legislation. The administrative processes for preparing, assessing and reviewing planning permits are also explained.

Part Three provides the methodology used by floodplain management authorities when assessing

development proposals referred to them. This is achieved by considering four objectives:

- safety
- flood damage
- off-site impacts
- waterway and floodplain protection.

This results in development outcomes that respond appropriately to the flood risk. Sometimes this means no development is appropriate.

Part Three has been written specifically for floodplain managers. If the information in this part is too technical, you should seek advice from a floodplain manager.

Why the guidelines are necessary

Victoria has many floodplains and overland flow paths, each with distinctive characteristics. This makes managing development in flood affected areas challenging. The risks posed by flooding are not equal from one floodplain to another, and the level of risk varies even within a discrete floodplain area. Understanding flood behaviour is crucial to any assessment of flood risk.

Historically, development has often occurred in floodplains and coastal areas. Some reasons for this are the availability of water for drinking, ease of transportation, amenity and recreation. The benefits of regular flooding to agriculture also means that towns were established on river flats to act as service centres for surrounding rural areas.

Victoria's variable climate means the flood risk is not always obvious to someone who wants to develop.

Current population projections for Victoria indicate continuing growth in urban areas. This creates pressure to extend development into areas affected by flooding and previously set aside as 'too difficult' to develop. Managing this development is important if we are to avoid increasing costs associated with flooding of built up areas.

These factors support a need to provide transparent guidance on how proposals to use and develop flood affected land are assessed.

There are also some state government drivers that support the guidelines.

The Victorian Floodplain Management Strategy

The *Victorian Floodplain Management Strategy* sets the direction for floodplain management in Victoria. Part 2, “avoiding or minimising future risks,” endorses the use of planning controls to manage the potential growth in risk. The guidelines respond to Objective 3 in the strategy: “not making things worse.”

Planning and Environment Act

The guidelines respond to several planning objectives set out in the *Planning and Environment Act 1987*:

- to provide for the fair, orderly, economic and sustainable use and development of land;
- to secure a pleasant, efficient and safe working, living and recreational environment for all Victorians and visitors to Victoria
- to facilitate development in accordance with the objectives in the Planning and Environment Act.

Who should use the guidelines

Floodplain Managers

The guidelines are primarily a tool for those providing flood advice to assess development proposals. Floodplain managers are employed by Melbourne Water and the Catchment Management Authorities. There are some situations in which council officers have a role (see Chapter 4).

Flood advice is mostly provided for individual development proposals requiring a planning permit. Flood advice can also be provided for strategic land use planning, such as when rezoning is proposed. This is explained in greater detail in Chapter 5.

Council Staff

Councils are involved in administrative processes in amending planning schemes, authorising a specific use or development of land through planning permits, or through regulating building permits. Where referral arrangements enable the floodplain management authorities to provide flood advice, there is usually no requirement to understand the technical nature of flood behaviour.

Where there are no referral arrangements to the floodplain managers, council staff are sometimes required to make their own assessments of development proposals.

Private Building Surveyors

Most councils have municipal building surveyors on staff or contract, and they are responsible for the building control functions of councils. This includes the issuing of building permits.

Building surveyors are authorised to assess building plans with a view to ensuring they comply with the *Building Act 1993*, the *Building Regulations 2018* and the *National Construction Code*.

Developers

Developers do not usually have technical training to appraise flood risk. However, developers may find the guidelines of benefit to understand how and why decisions are made.

Applicants are encouraged to contact the floodplain management authority for feasibility advice. Many councils also encourage applicants to seek advice from planning and development staff before lodging an application.

Pre-application advice can allow floodplain managers and council staff to provide general feedback and identify key planning considerations. Decision making should be based on the best available information for assessing flood risk. Early identification of the issues and available information can help reduce requests for changes and further information following lodgement.

How to use these guidelines

As the target audience varies from floodplain managers to councils to developers, a brief overview has been provided at the start of each chapter, in plain English.

Users can read the detail in each chapter if greater understanding is required.

Key principles for development

The following principles are relevant to these guidelines:

The flood risk to people (including emergency services personnel) should be kept to acceptable safety thresholds, as per the latest updated Australian Rainfall and Runoff Guidelines.

People become vulnerable if they walk, ride or drive through floodwater. Research into the stability of vehicles and people allows us to consider the combination of flood depths and flow velocities that leads to hazardous conditions. This applies to

emergency services personnel as much as the building occupants.

Any development in a flood affected area, including associated infrastructure, should be planned to avoid or minimise the flood damage potential.

Consideration of what a building is made of, and what can be done to protect a building's contents from flooding, will reduce the flood damage potential.

Given the future impacts of climate change, and higher densities of residential development, development that relies on new or extended flood mitigation infrastructure to provide flood protection should not occur if alternatives are available. Flood mitigation infrastructure is not fail-safe and is dependent on ongoing management and maintenance.

There should be no detrimental impacts to nearby properties, particularly properties downstream.

Developers must give due consideration of the impact of the development on others. Locating buildings and works in areas that are important for flow conveyance or flood storage can increase flood levels and flow velocities locally.

Development should preserve, and if possible enhance, the social and environmental values and benefits of floodplains and waterways.

Waterways and floodplains often have significant environmental attributes. These can be threatened if development occurs too close to these natural assets, or if water from a development site is not controlled.



New dwelling on a fill pad
Credit: Ian Gauntlett, DELWP

2. Flood risk management

Floods are part of the Australian landscape. Because of Australia's highly variable climate, the hazardous nature of flooding is not always obvious. Flood studies are a necessary first step to understanding flood behaviour.

Flooding occurs when water covers land that is normally dry. In Victoria, the three main types are riverine, overland flow and coastal flooding. Flooding from dam failure is not considered in the guidelines.

- Riverine flooding occurs when water escapes or is released from the normal confines of a lake, river, creek or other natural watercourse, whether altered or modified. It also includes water that has escaped or been released from any reservoir, canal or dam. For catchments with high altitude areas, snow melt can influence riverine flooding, and this needs to be considered in the flood modelling.
- Overland flow (sometimes called stormwater flooding) occurs when runoff from heavy rainfall moves over the landscape, following the grade of the land. Flooding can occur by several mechanisms: local runoff exceeding the capacity of urban stormwater drainage systems; floodwater flowing overland through poorly defined drainage paths; and water backing up through drainage systems.
- Coastal flooding occurs in low-lying coastal areas, including estuaries. It can be caused by storm surge events, very high tides or both. Properties that may currently be above tidal or storm surge levels may be at risk under future climate change scenarios. These predict rising sea levels and increasing storm surge intensity.

Flood behaviour

Flood behaviour varies with the type of flooding, the location and intensity of development, the shape and size of the catchment and the slope of the ground. As explained in Australian Disaster Resilience Handbook 7 the safety of people and the susceptibility of structures are linked to flood behaviour.

Flood studies

Flooding remains one of the most predictable natural hazards encountered in land use and development planning. It is relatively straight forward to predict and measure aspects of flood behaviour through flood studies with a high level of confidence. Flood studies look at flood behaviour for a range of floods, from small to very large.

Flood studies need to be updated periodically, as they are dependent on the best available data, which is influenced by many factors, including:

- changes in land use
- changes in topography (such as the removal of an irrigation channel that is no longer required, road raising or land fill)
- a longer record of flood data
- climate change.

Updated technology and improved guidance on mapping standards also improve the quality of the flood studies.

Information from flood studies is incorporated in planning schemes. See Chapter 5.

Authorities are encouraged to share information from flood studies with other authorities so that decision making is informed by the best available data.

Flood risk

Flood risk is determined by the frequency of flooding and the potential economic, social and environmental consequences to the community. They are interlinked: the less frequent the event, the larger the potential consequences.

Usually, it is not practical to eliminate the flood risk. A challenge for the floodplain management authorities is to determine what flood risk is acceptable to the community.

Future growth in the flood risk can be limited by encouraging development intensification away from areas of high hazard. Where development does occur on flood affected land, the risk must be reduced at the property scale. Examples include elevating the floors of buildings and flood proofing.

Risk reduction solutions are not always appropriate. They need to be considered in terms of the impacts on people, property and the environment.

The nature and understanding of flood risk are not set in stone. Changes in topography, climate change, a longer record of flood data and other

factors can signal changes to the flood hazard. Changes in demographics also affect the human interaction and exposure to the flood hazard. Development proposals are therefore assessed against the best available information, not by comparing what might have been previously allowed for other developments in an area.

Flood probability

The best way to express probability when talking to the community about flood risk is using percentage Annual Exceedance Probability (AEP). This refers to the probability each year of a certain size event being exceeded and reinforces that there is an ongoing flood risk every year. If a site experiences a flood at a point in time, it could experience another similarly sized event, or a larger one, the next month, the next year, over the next decade or two hundred years later. Floods occur randomly and in different magnitudes.

Flood variability

Piped drainage systems are usually designed for the more frequent floods. Larger floods causing significant community impacts may occur at the same location several times in a lifetime, or sometimes, not within a lifetime.

Flood behaviour is never uniform. A severe storm may result in severe flooding at one location and little or no flooding at another location.

Cumulative impacts

Cumulative impacts must be considered in development proposals, even if one application on its own does not have measurable impacts on flood behaviour. The cumulative impact of many development proposals can result in changes to the flood extent and depth, and the flow velocity.

Some flood studies may account for the broad effects of changing development patterns. If not, it may be necessary to impose tight controls on development to offset the cumulative impacts.

The design flood

The probable maximum flood (PMF) is the largest flood that could possibly occur in a particular location. It is an extremely rare flood, which when it does occur, can result in significant community disruption and loss of life. It is not usually feasible, or socially or economically justifiable to adopt the PMF as the standard for all floodplain management activities.

In Victoria, the 1% AEP flood is the design flood that most affects most decisions on development. Suffering the economic impact of rarer events is considered tolerable for most sectors of the community. Floods larger than the 1% AEP flood can and do occur.

The 1% AEP flood is also known as a 100-year Average Recurrence Interval (ARI) event. This does not mean that, if an area has experienced a “one-in-one hundred flood” it won’t have another flood for the next 100 years.

Floods vary greatly in size and frequency. Governments generally provide additional support or implement additional measures for a range of floods, including the more hazardous ones. Examples include flood warning systems and emergency management plans. Key community infrastructure such as power supplies, communication centres, emergency response headquarters and evacuation centres may also require additional protection. They need to be fit for purpose in emergency response and recovery.

Flood safety considerations

Depth and velocity

The most important determinants of flood hazard are the flood velocity and flood depth. Fast-flowing, shallow water, or slow-moving, deep water can unbalance people and sweep them away. Buildings can be undermined or damaged by floodwater and debris. The contents of buildings can also be severely damaged or destroyed.

Research by the Bushfire and Natural Hazards CRC reveals that about half of all documented fatalities are from people driving through floodwater. Flood awareness does not significantly affect their choice; neither does the availability of flood warnings. More detailed information on the research is provided in Appendix 1.

Detailed information on the safety of people in floods is provided in Book 6, Chapter 7 of *Australian Rainfall and Runoff*. It applies to vehicle stability criteria, the safety of children and adults in floodwater and the stability of buildings. The information is based on controlled conditions and / or assumptions made on the data and subjects analysed. Some important qualifiers include:

- The test data excludes infants, very young children, physically and / or mentally disabled people and frail older persons. Such people are more vulnerable than children and adults.

- The ability to withstand flood flows is influenced by the mental disposition, perception, specific training and experience of the person affected.
- The information in *Australian Rainfall and Runoff* excludes the inherent dangers of drivers losing control of vehicles under speed (aquaplaning) and people swimming through floodwater.

Wading through floodwater may result in injuries because you can't see what is beneath the water. Potential obstacles can include an uneven ground surface, potholes, fences, major storm water drains, displaced manhole covers, flood debris, pollutants or dangerous fauna.

Walking short distances through safe flood depths and velocities may be possible, but there will still be a risk of injuries. Walking long distances through floodwaters requires sustained physical exertion and increases the potential exposure to obstacles below the surface of the water.

Driving through floodwater can result in a loss of control of the vehicle. Once a vehicle loses traction it can float, be pushed or topple into deeper water. Electric systems that lock doors and wind down windows can also fail, making extraction from the vehicle difficult.

Isolation

How long floodwaters remain present can also be important if it leads to people being isolated. Isolation can result in people entering unsafe floodwaters to access services, employment or family members. Any situation that increases people's need to cross floodwaters increases the likelihood of an injury or fatality.

The impacts of isolation include:

- People are cut off from transport, drinking water, medical treatment, sewerage and electricity.
- People can run out of food and drinking water.
- It diverts limited resources of emergency services away from other activities.
- Anxiety (as rescue may not be possible).

For this reason, consideration needs to be given to ensuring there are safe, external connecting routes

that do not lead to isolation. They should safely connect to emergency relief services, not just to the nearest high ground.

Isolation is not an issue for short duration flooding, such as occurs when urban drainage systems are overloaded. How quickly floodwaters rise and fall does become important however, as it restricts the time available for safe evacuation, and flow velocities can often still be quite high. Judgement is still required about the exposure of people to flood debris, the length of an evacuation route through floodwater and the likelihood of being swept into deeper floodwater.

Frequency of flooding

The frequency of flooding also contributes to the flood risk. Any floodwater on a site will affect the occupants to some degree. The more often people evacuate, the greater the cumulative exposure to wading or driving through floodwater.

Vulnerability

Some individuals or groups of individuals are dependent on more able people for mobility and basic needs. They include the elderly, infirmed, mentally or physically incapacitated, incarcerated and very young children. *Australian Rainfall and Runoff* considers them to be unlikely to be safe in any flow regimes.

There are also services that the community expects in times of flood. Buildings that are linked to these services include ambulance stations, police stations, fire stations, communication facilities, transport facilities, community shelters and emergency service facilities.

Such facilities should be located outside the 1% AEP flood extent. If this is not feasible, the development proposal should determine how the site safety and building operation issues can be addressed.

Buildings housing vulnerable people and community services often have a high flood damage potential. If it is not feasible to locate these facilities outside flood affected areas, a higher freeboard may be applied by the floodplain management authority to offset the impacts.

3. Climate change

Rising temperatures in the Earth's atmosphere are strongly linked to human activity. This leads to increased sea levels and incidences of the extreme rainfall that drives flooding.

As far as practicable planning of settlements should discourage development intensification for areas predicted to have a high flood risk in coming decades, unless strategies are in place to mitigate the impacts.

There is now widespread acceptance that human activities are contributing to observed climate change. This has the potential to alter the prevalence and severity of rainfall extremes, storm surge and floods. Recognition and management of the risks associated with climate change will help reduce future impacts.

Impacts on flood behaviour

Riverine and overland flooding

Climate change is expected to result in significant changes in storm behaviour. The information currently available suggests that the extreme rainfall events that drive major flooding are likely to increase over the next few decades. However more detailed research is required to identify how the global and regional trends affect flooding.

Australian Rainfall and Runoff (Book 1 Chapter 6) provides interim guidance and a methodology that can be considered in flood studies. The first step is to establish the life of the infrastructure. The next step is to apply an increase in the design rainfall intensity, based on a consideration of climate change.

If flood studies have not assessed the impacts of climate change, allowance should be considered through applying additional freeboard to development proposals.

Coastal flooding

Climate change is also expected to result in sea level rise. Most of this is associated with thermal expansion of the Earth's oceans and melting ice caps. Sea levels will continue to rise for many decades, even if strong action is taken worldwide to curb emissions. Sea level rise will increase the extent and duration of tide and storm induced coastal inundation.

Coastal flooding is also influenced by high tides, and storm surge, which is the rise in seawater level during a storm. Coastal hazard assessments look at these effects, and the potential impacts of coastal erosion.

Combined flooding

Estuaries are sensitive to a combination of coastal flooding and riverine or overland flooding. This adds to the complexity of flood investigations, as a joint probability analysis is required. *Australian Rainfall and Runoff* (Book 6 Chapter 5) provides guidance for those experts able to understand and apply the suggested methods.

Current policy setting

There are two important documents that contain policies relating to climate change: the *Victorian Floodplain Management Strategy 2016* and the *Victorian Coastal Strategy 2014*, which will be superseded by a *Marine and Coastal Environment Strategy* around 2020.

Victorian Floodplain Management Strategy

The *Victorian Floodplain Management Strategy* acknowledges the impacts of climate change on weather. This includes changes in average stream flows, increased stream flow variability, more intense storms and increased sea levels.

Uncertainty about future rainfall requires preparation for a range of climate conditions. Policies in the *Victorian Floodplain Management Strategy* provide requirements for flood studies to:

- consider a location's sensitivity to climate change
- meet the needs of a range of users (including land use planning)
- be of sufficient quality for inclusion in planning schemes

- consider, as relevant, the state policies embedded in planning schemes.

The Department of Environment, Land, Water and Planning will support local councils and their communities to strengthen their capacity to adapt to the effects of coastal flooding. Where councils amend their planning schemes to show land subject to inundation by coastal flooding, the Catchment Management Authorities and Melbourne Water will act as referral authorities for applications to use and develop land.

Victorian Coastal Strategy

The *Victorian Coastal Strategy 2014* establishes the long-term framework for the planning and management of the coast. It sets out the state's policies on coastal hazards and benchmarks for planning for sea level rise. The coastal environment includes land directly influenced by the sea or directly influencing the coastline, and the rivers and drainage systems that affect the coastal zone, including estuaries.

The Victorian Coastal Strategy was established under the *Coastal Management Act*, which has been replaced by the *Marine and Coastal Act 2018*. The new Act will introduce significant changes to coastal policy through a multi-year transition plan, including:

- developing improved climate change impact projections for the Victorian coast
- preparing a state-wide policy for the marine and coastal environment
- preparing a state-wide strategy for the marine and coastal environment (to replace the Victorian Coastal Strategy)
- extending the role of Catchment Management Authorities to include providing advice on coastal erosion and greater coverage of coastal and marine issues in the next round of Regional Catchment Strategies in 2019-20
- reviewing planning benchmarks for sea level rise
- considering how climate change and adaptation policy can be strengthened through the planning and building systems
- supporting strategic planning for coastal settlements and areas that reflects the best available coastal and erosion climate science
- establishing state-wide objectives, standards, databases, and guidance to build capability and

understanding of coastal erosion and flooding in Victoria

- ensuring a greater role for Traditional Owners in formal management and planning for marine and coastal areas.

Coastal processes cross land tenure, land management, jurisdictional and policy boundaries. The Victorian Coastal Strategy takes a holistic view of coastal management. This will continue with the changes.

Some of the desired outcomes are:

- updating sea level rise planning policy benchmarks in the Policy Planning Framework in planning schemes
- aligning the growth of coastal settlements with the strategic directions for settlements identified in Regional Growth Plans
- maintaining non-urban breaks between coastal settlements to preserve the character of the coastline
- ensuring that new development and redevelopment on the coast protects environmentally and culturally significant places, accommodates biodiversity, connectivity and adaptation, does not interfere with natural coastal processes, and avoids areas subject to coastal hazards.

Application of climate change policies

The additional impacts of climate change are gradual. However, once communities are established, it is difficult for them to retreat because of a flood threat.

If urban growth is planned, consider the most suitable location. This should be informed by flood studies and coastal hazard assessments. The flood controls in planning schemes may need to be updated if there are significant changes to the predicted flood behaviour.

Melbourne Water and the Catchment Management Authorities have prepared separate guidelines for assessing development in areas subject to coastal flooding. They are listed in the bibliography. Development proposals will be assessed against those guidelines where appropriate.



Part Two - regulation

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4. Legislation

Legislation provides the authorising environment and establishes the arrangements for regulating land use and development. To be effective, floodplain management authorities and municipal councils need to work in partnership.

Relevant legislation

Planning and Environment Act

Victoria's statutory land use planning system operates through planning schemes, which are subordinate instruments under the *Planning and Environment Act 1987*. Section 62(e) of the Act enables planning schemes to 'regulate or prohibit any use or development in hazardous areas, or areas likely to become hazardous'. As a result, planning schemes contain land use and development controls to enable flood risk to be managed.

Building Act

The *Building Act 1993* governs building activity in Victoria. It sets out the legislative framework for the regulation of building construction, building standards and the maintenance of specific building safety features. The *Building Regulations 2018* are subordinate instruments under the Building Act. The *Building Code of Australia* is adopted by and forms part of these regulations. This in turn is incorporated into the *National Construction Code*.

Water Act

Part 10 of the *Water Act 1989* enables floodplain management authorities to have waterway management, regional drainage and floodplain management functions. Specific activities are guided by the *Victorian Waterway Management Strategy*, the *Victorian Floodplain Management Strategy* and the *Victorian Rural Drainage Strategy*.

A key floodplain management function is to advise about flooding and controls on development to local councils, the Secretary to the Department of Environment, Water, Land and Planning and the community.

Climate Change Act

Part 4 of the *Climate Change Act 2017* requires the Victorian Government to endeavour to ensure that any decision, policy, program or process developed or implemented by the Government to appropriately consider climate change, if relevant by having regard to the policy objectives and guiding principles, listed in that part of the Act.

The most relevant policy objectives are to:

- build the resilience of the state's infrastructure, built environment and communities through effective adaptation and disaster preparedness action
- manage the state's natural resources, ecosystems and biodiversity to promote their resilience
- support vulnerable communities and promote social justice and intergenerational equity.

The most relevant key guiding principles relate to informed decision making, integrated decision making, risk management and equity. Decisions relating to climate change should be based on:

- a comprehensive analysis of the best practicably available information about the potential impacts
- an integrated consideration of all relevant issues
- assessing, managing and allocating the risks in a manner that is easily understood, aims to achieve best practice and avoids, wherever practicable, serious or irreversible damage
- creating opportunities to increase capacities for current and future generations to adapt to climate change
- considering the long-term, medium-term and short-term consequences.

Other Acts

Developers may need to comply with other legislation, where there are potential impacts on environmental, cultural and landscape values. They include:

- the *Commonwealth Environment Protection and Biodiversity Act 1999*, which provides for the protection of matters of national environmental significance, including nationally significant threatened species and wetlands protected under the Convention of Wetlands of International Importance (the Ramsar Convention)
- the *Flora and Fauna Guarantee Act 1988*, which provides protection for species and ecosystems that are of state-wide importance
- the *Aboriginal Heritage Act 2006* and *Aboriginal Heritage Regulations 2018*, which set the framework for identifying and protecting Aboriginal Cultural heritage.

Roles and responsibilities

The administration and enforcement of a planning scheme is the duty of a responsible authority. Usually this will be a local council, but it can be the Minister administering the Planning and Environment Act 1987 or any other Minister or public authority specified in Clause 61.01 of the scheme.

Councils play a significant role in managing extensive networks of stormwater drains, which can often be the cause of flooding.

Melbourne Water and the nine regional Catchment Management Authorities are floodplain management authorities. They provide flood information and development advice to municipal councils, who administer the planning schemes and building regulations. They also apply advice to others, for example requests for flood information.

For flood impacts to be managed holistically, collaboration between councils and floodplain management authorities is essential. Arrangements vary, depending on the working relationship between the floodplain management authority and the relevant council, and whether the flood hazard has been identified in the planning scheme.

Sometimes councils will consider flood impacts without seeking advice from floodplain management authorities. The localised nature of the flooding may be better understood by council, or there may be a written agreement exempting a need for referral.

Compliance with the guidelines will not give immunity from prosecution. Those involved in decision-making will still need to take reasonable care that granting a permit does not lead to negligence claims.



Flood protection levee – Rochester Water Treatment Plant

Credit: North Central Catchment Management Authority

5. Regulating development

Most forms of development will require a planning permit, a building permit or both. This chapter describes the requirements. The process of applying the flood controls is described in Chapter 6.

The difference between planning and building

The planning permit and building permit systems operate under different forms of legislation. Planning permits are legal documents giving permission for a land use or development. Building permits relate specifically to the carrying out of building construction.

Most forms of development in flood affected land require a planning permit. They include subdivisions, buildings and works.

If building construction is proposed in a flood affected area or in a waterway, Building Regulations 153 or 154 also apply, unless dealt with through the planning permit system. The report and consent of the relevant council must be obtained. Before giving consent, the council must consult with Melbourne Water or the Catchment Management Authority.

Figure 1 shows the differences between the two systems.

Planning schemes

The planning scheme determines the circumstances in which a planning permit is required. Just because a person can apply for a permit does not imply that a permit should or will be granted.

The planning scheme lists the matters that councils must consider. They include:

- the state and local planning policies
- the purpose of the zone, overlay and any other provision
- the degree of flood hazard associated with the location of the land and the use, development or management of the land to minimise the hazard.

Before flood provisions can be introduced to a planning scheme, information on the type and extent of flooding is required to accurately map land affected by flooding and apply the most appropriate flood provision.

Unlike most controls for the use and development of land, the flood zone and the flood overlays do not represent the full extent of flooding. Floodplain management planning is about planning for an acceptable level of risk.

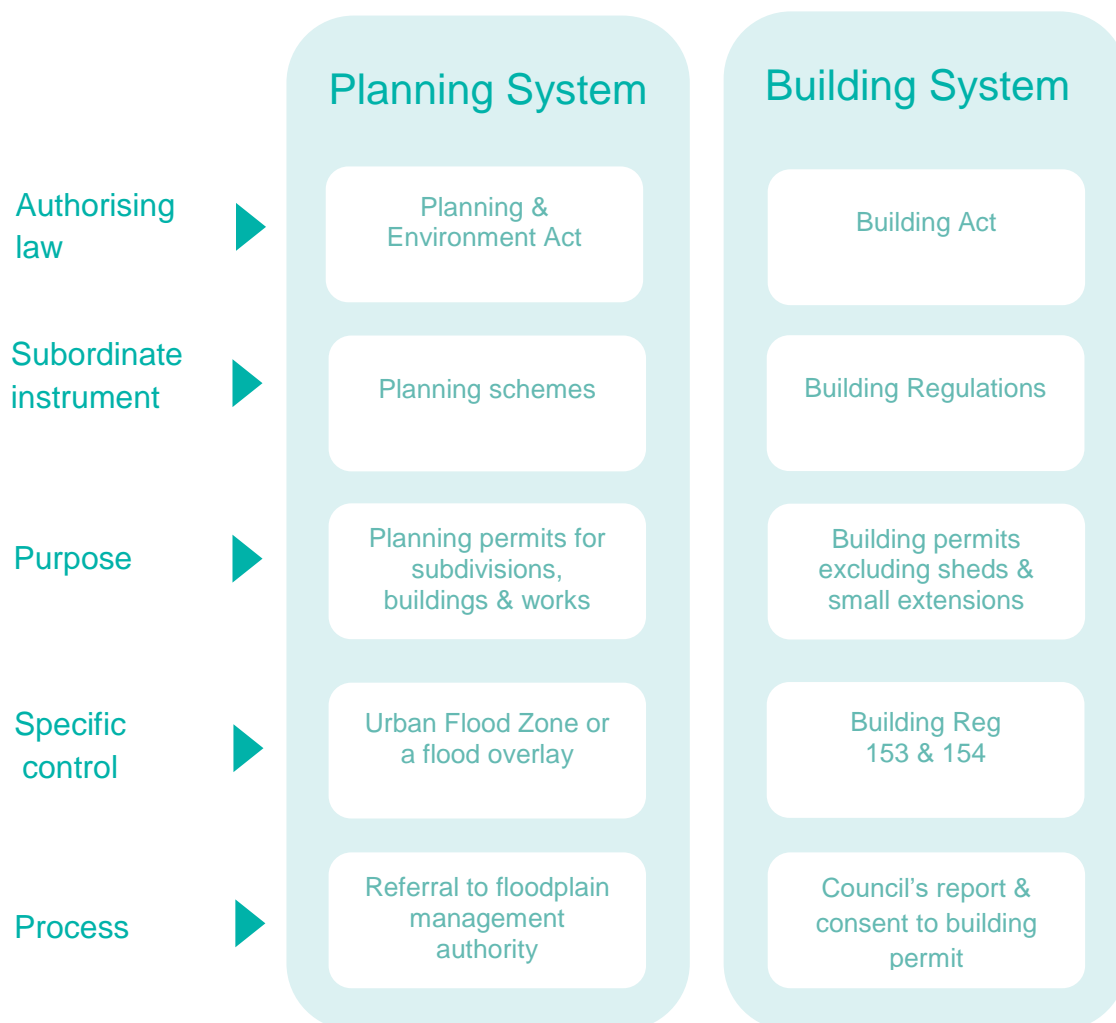


Figure 1: The planning and building frameworks

State, regional and local planning policies

Planning policies are transitioning into a new integrated framework that provides for three tiers of planning policy: state-wide, regional and local. Mandatory policies of state significance and regional policies of state significance have been migrated into the new framework. They are based on geographical and thematic policy groupings. Over time, policies of local significance in the Local Planning Policy Framework will be introduced into the new framework. Both the old and the new systems allow for local flood issues to be addressed.

Planning policies specifically relevant to these guidelines include:

- Water bodies and wetlands (Clause 12.03).
- Climate change impacts (Clause 13.01).
- Floodplains (Clause 13.03).
- Water (Clause 14.02).

These policies support the following:

- Identify land affected by flooding.
- Avoid intensifying the impacts of flooding through inappropriately located uses and developments.
- Plan for sea level rise and associated coastal effects.
- Ensure development does not compromise bank stability, increase erosion or impact on a water body or wetland's natural capacity to manage flood flow.
- Ensure development is sensitively designed and sited to maintain and enhance environmental assets, significant views and landscapes along river corridors and waterways and adjacent to lakes and wetlands.
- Retain natural drainage corridors with vegetated buffer zones at least 30 metres wide along each side of a waterway to: maintain natural drainage function, habitat and landscape values; to minimise erosion; and to reduce polluted surface runoff from adjacent land uses.

Zones

Each planning scheme zones land for particular uses, for example, residential, industrial, business, rural or farming. Each zone has its own purpose and set of requirements.

An Urban Floodway Zone is sometimes used in urban areas of high flood hazard, to support the natural function to convey and store floodwater. It is the strongest flood control.

An Urban Floodway Zone provides limited opportunity for most forms of development. Low development intensity uses that are compatible with the flood storage and conveyance function are generally permitted. They include agriculture, bee keeping, grazing of animals, and some forms of temporary trading, leisure and recreation (Clause 62.01 provides more specific details).

The Urban Floodway Zone is not often used, because of its restrictive nature. More commonly, a flood overlay is used in conjunction with an appropriate zone (such as residential, farming or rural). This allows the primary use of the land to be recognised at the same time as acknowledging its flooding characteristics.

Flood Overlays

Flood overlays identify where a planning permit may be required for subdivision, the construction of a building, or other changes to the land. Where data is available, flood related overlays typically reflect the 1% AEP flood hazard. Not all areas at risk of flooding are covered by overlays.

The three main types of flood overlays are described below. They do not define the absolute extent of flooding, which is defined by the probable maximum flood. Flooding outside the flood overlays will still occur at some stage. The purpose of the overlays is to define what is considered an acceptable threshold for managing flood risk.

Floodway Overlay

Floodways are those parts of the floodplain that are important for the discharge or storage of water during major floods. They are usually aligned with naturally defined waterways, channels and depressions and often carry relatively deep and high velocity flows.

Floodways can be defined in various ways, depending on what data is available. Some common methods include considering various combinations of depth and flow velocity, identifying those parts of the floodplain that are important for conveying or storing floodwater, or mapping a flood extent corresponding to a major flood, say a 10% AEP event.

Filling or even partial blockage of floodways can redistribute flood flows, causing increased flood

levels and flow velocities and increased flood risk for nearby properties.

A blockage of a floodway can also have adverse environmental impacts, such as isolating wetlands, destroying natural habitats, eroding stream channels and increasing siltation.

A Floodway Overlay provides transparency over what forms of development are likely to be inappropriate because of the high flood risk. It is the strongest form of flood overlay.

Flood overlays specify certain types of development that do not require a planning permit.

Land Subject to Inundation Overlay

The Land Subject to Inundation Overlay applies to riverine and coastal flooding and represents the area of land flooded by the 1% AEP flood. If the high hazard Floodway Overlay component has also been identified, it is excluded from the Land Subject to Inundation Overlay.

Special Building Overlay

The Special Building Overlay applies to stormwater flooding. It is used to recognise that many urban drainage systems were designed for much lower storm capacity than the 1% AEP flood. Usually no provision was made for overland flows, so land is often flooded when the capacity of the underground drainage system is exceeded. The Special Building Overlay enables development to be managed in these areas.

The Special Building Overlay includes standard exemptions for common urban developments such as minor extensions to dwellings, replacement fencing, carports, pergolas and in-ground swimming pools.

Schedules

In addition to standard exemptions for some types of development, the overlays can also contain schedules. A schedule exempts certain types of buildings and works from the need for a permit. This reduces the number of planning permit applications the council and the flood plain management authority need to process.

Schedules are used in low risk situations. For example, rural shires often have large farming communities, which are affected by slow and relatively shallow flooding. It may therefore be appropriate to include a hay shed in a schedule.

Such exemptions should only apply to low risk situations.

Local Floodplain Development Plans

A local floodplain development plan enables the council and local floodplain management authority to include specific local requirements in the planning scheme. It is a way to insert detail into the planning scheme where overlay schedules are inappropriate. Consideration can also be given to special circumstances, for example introducing requirements for specific types of development. It simplifies and streamlines the work required to prepare and assess planning permit applications.

Each plan provides a set of requirements and guidelines for development in an area. It should address local circumstances and record local flooding information.

If a local floodplain development plan has been developed for a specific area and has been incorporated into the planning scheme, an application must be consistent with the plan.

Local floodplain development plans are prepared by municipal councils in consultation with the floodplain management authorities. Once a council has adopted the plan, it is incorporated into the planning scheme via a planning scheme amendment.

Decision guidelines in planning schemes

Issuing a planning permit can be challenging: the relevant Council must determine that the proposal will produce acceptable outcomes. For the flood zone and flood overlays, the matters to be examined are identified as decision guidelines. The things to consider are:

- The Municipal Planning Strategy and the Planning Policy Framework.
- Any Local Floodplain Development Plan.
- Any comments from the relevant floodplain management authority.
- The existing use and development of the land.
- Whether the proposed use or development could be located on flood-free land or land with a lesser flood hazard.
- The susceptibility of the development to flooding and flood damage.
- The potential flood risk to life, health and safety associated with the development.
- The effect of the development on redirecting or obstructing floodwater, stormwater or drainage water.

- The effect of the development on reducing flood storage and increasing flood levels and flow velocities.
- The effect of the development on river health values including wetlands, natural habitat, stream stability, erosion, environmental flows, water quality and sites of scientific significance.

The Decision Guidelines do not provide guidance on how to decide whether proposed development is compatible with the flood risk, or what things are more important than others. This gap is addressed in Part Three.

The development guidelines are not intended to override the consideration of any overlays, their schedules, Local Floodplain Development Plans or local circumstances.

Further guidance

More information available through Planning Practice Note (Planning Practice Note 12, *Applying the flood provisions in planning schemes*).

Strategic planning

Inappropriate development in flood affected areas can lead to fundamental changes in the nature and impact of flooding. It can also increase the potential for loss of life and flood damages to the community and the environment. This is contrary to the objectives of planning in Victoria, listed in the *Planning and Environment Act 1987*.

The Development Assessment Framework in Part Three of the guidelines is primarily aimed at property-specific development. It can also be used by municipal councils for strategic planning. In principle:

- Land should not be rezoned for a higher density land use without adequate consideration of the flood risk, including the cumulative impacts, and loss of safe access during floods.
- Land that is affected by flooding should be identified by a flood overlay, unless it is zoned for flood purposes. This makes the flood risk clear to all and provides the necessary trigger for development proposals to be referred to a floodplain management authority. It also enables future purchasers of land to be informed of the flood risk through vendor disclosure statements.

Any rezoning to a higher density land use should consider 'the island effect,' where access to flood-free ground is lost during floods. Residents can be physically cut off from their home or workplace, which increases the risk of people entering floodwater.

Sustained isolation can affect the ability of residents or communities to function normally. They can also lose access to food and essential services such as water, sanitation and electricity. This increases the burden on emergency service providers to supply residents with basic needs and potentially risk the lives of their staff.

Councils should consult with their local floodplain management authority when undertaking strategic planning. This enables the specialist advice on flood behaviour to be considered along with the other matters that planners need to consider.

Redevelopment of existing sites can be challenging if the current use of the land permits intensifying urban development. Redevelopment often increases the area of impermeable surfaces, resulting in deteriorating water quality and increased flows in existing drainage systems. Clause 53.18 and Clause 56.07 in planning schemes provide guidance for how this can be addressed. Detailed modelling will usually be required to assess how development intensification affects flood behaviour.

Cumulative impacts

It is often difficult to estimate small changes in flood behaviour for individual development proposals. Over time these small changes accumulate, which can result in more frequent flooding if stormwater systems are overloaded. It can also increase the depth, velocity and extent of flooding.

Flood mapping that considers changes in flood behaviour for cumulative impacts can be useful for strategic planning. One way is to require flood modellers to adjust the ratio of impervious surfaces to pervious surfaces in their computer models. Another way is to require sensitivity testing of the impacts of increased development on flood behaviour, including the impact on stormwater drainage. Significant changes in flood behaviour may require structural works, such as retarding basins.

Levee protection

Well maintained levees can provide community protection to the 1% AEP standard (plus freeboard). The flood provisions on the "dry side of a levee"

should only be removed if the drainage systems are able to fully control localised flooding.

Levees cannot be guaranteed to provide flood protection in all circumstances. Therefore, the emergency management plan for the affected community must provide for the potential for sudden and complete failure of that infrastructure.

Regulating buildings

The reduction of flood damage to buildings and their contents is also controlled through the *Building Regulations 2018*. The regulations adopt the *Building Code of Australia* with a few modifications.

Regulation 153 requires the consent of the council for a building permit if a site is subject to inundation. The council must specify a minimum floor level for the proposed building in consultation with the relevant floodplain management authority and assess the flood risk associated with the site. The council must not consent to a permit if it believes that there is a likely danger to the life, health and safety of the occupants of the building due to flooding of the site.

The council must specify a minimum floor level with a freeboard margin of at least 300 mm above the 1% AEP flood level, unless the floodplain management authority consents to a lower level. The regulations do not apply to a Class 10 building (non-habitable garage, carport or shed), an unenclosed floor area of a building or an extension to an existing building which is less than 20 square metres.

Regulation 154 requires the consent of the council for a building permit for a building on designated land or designated works. Designated land and designated works are defined in the Water Act.

Before giving its consent, the council must consult with Melbourne Water or the Catchment Management Authority.

Section 194 of the Water Act creates an offense for works which interfere or affect the quality, quantity or flow of water in designated land or works within an Authority's waterway management district.

Building standards

The *National Construction Code* requires that a building or structure does not collapse when subject to the action of liquids, ground water and rainwater ponding. A standard and handbook have been developed to provide more specific requirements for building construction in flood hazard areas. Deemed-to-satisfy provisions require buildings to be subject to flood velocities less than 1.5 metres per second. Above this threshold, the building must be designed by an expert to withstand flood impacts.

Floodplain managers do not have the expertise to assess the structural integrity of buildings. These guidelines do not address building design or building safety.

6. Applying the flood controls

This chapter provides a general overview of the process of preparing, assessing and reviewing planning permits, for the benefit of those unfamiliar with the planning system.

A planning permit allows a certain use or development to proceed on a parcel of land. It is required for most forms of development on flood affected land.

Development includes the construction, alteration or demolition of a building or works and the subdivision or consolidation of land.

A council will impose conditions when granting a permit and endorsed plans will also usually form part of the permit. The proposal must satisfy all the conditions on a planning permit.

For the benefit of those not familiar with the planning system, a simplified procedure of the process is illustrated in Figure 2. More detail is available in Chapter 3 of *Using Victoria's Planning System*. This includes guidance on:

- amending applications
- fast-tracking eligible proposals through VicSmart
- the role of VCAT in reviewing planning decisions or processes
- the time taken to assess applications
- special categories such as subdividing land, restrictive covenants, and earth and resources industries.

Applying for a planning permit does not guarantee that a permit should or will be granted. The council must decide whether the proposal will produce an acceptable planning outcome. Decisions are guided by planning policies in the planning scheme and the decision guidelines in Clause 65 of the planning scheme, the zone and the flood controls.

Feasibility advice

Consulting the relevant council before formally applying for a planning permit can be useful as:

- a planning permit may not be required
- the planning scheme may prohibit the proposed use
- it allows the applicant to focus on those aspects of the proposal which require a permit.

Discussing the initial plans with neighbours can ascertain concerns and modify the proposal before it is fully developed. This is not mandatory, but these discussions may avoid an objection at the application stage.

Seeking feasibility advice from floodplain managers can help an applicant refine or modify the proposal, to avoid potential rejection, or onerous conditions. The floodplain manager will be able to advise what information is required to help assess the proposal. This reduces the likelihood of being asked to supply additional information after a planning permit application is lodged.

As explained below, there are ways for flood advice to be considered without a need for a referral. This can reduce the time for the council to decide on the application.

Establishing good working relationships between councils and floodplain management authorities will enable the efficient use of knowledge and skills. Agreements can be established on what information is required by the floodplain manager and if there are local considerations that could influence decision making.

A request for flood advice can also come from the community, rather than from a municipal council, as:

- people interested in purchasing properties often want to understand the flood risk
- developers are interested in the likelihood of gaining approval for a development proposal.

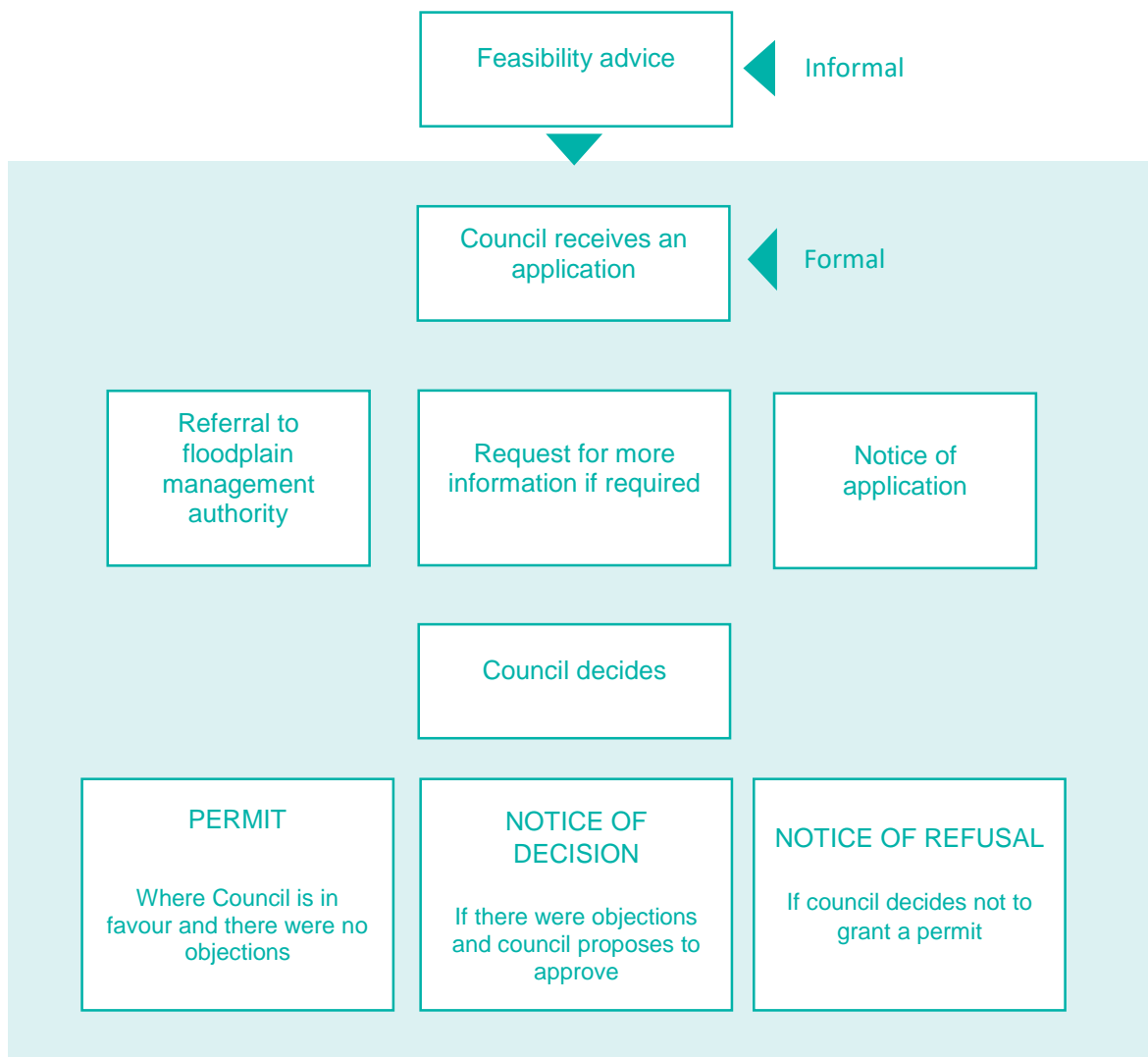


Figure 2: Applying for and assessing a planning permit

Receiving an application

An application must be made to the relevant council in accordance with the *Planning and Environment Regulations 2015* (the Regulations). The application must be accompanied by the prescribed fee and information required by the planning scheme. Before lodgement, it is helpful to check with the council planning officer that:

- the application is accompanied by any information required by the planning scheme
- an accurate description of the land has been given
- the proposal has been described satisfactorily

- it includes a copy of any registered restrictive covenant affecting the land
- the application addresses the state and local planning policies (see Chapter 5)
- the application addresses the relevant planning scheme provisions
- the application fee has been paid
- the applicant is the owner of the land or has notified the owner of the land about the application.

To avoid delay, proposals in flood affected areas should be supported by information about the property, what is proposed and how it could impact on flood behaviour. The following information, in the

form of plans, cross sections, descriptions and any other data, should be provided, where relevant:

- the existing and proposed use of the site
- the number of people expected on-site during normal operations
- the existing natural surface levels and proposed finished surface levels (to Australian Height Datum)
- the existing and proposed buildings, including floor levels
- the existing and proposed earthworks, including crest levels
- the existing and proposed roads, including centre lines, kerbs, footpaths and crest levels
- the existing and proposed drainage systems, including waterways, pipelines, drains, culverts and bridges
- details of any other physical features that may affect flows, such as levees, fences and retaining walls.

Referral to a floodplain management authority

Floodplain management authorities are listed as referral authorities in Clause 66.03 of planning schemes. Section 55 of the *Planning and Environment Act, 1987* provides for planning permit applications to be referred to them.

The need for formal referral to the floodplain management authority can be avoided if:

- the authority specifies in writing that it does not object to the granting of a permit within three months before the council receiving an application
- in the council's opinion, the proposal satisfies requirements or conditions previously agreed in writing between council and the floodplain management authority
- there is an exemption in the schedule to an overlay.

Floodplain managers will assess the proposal against the guidelines, and any local considerations or guidance, and advise whether it:

- does not object to the granting of a permit
- does not object to the granting of a permit providing that certain conditions are included

on the permit, or that certain matters are done to its satisfaction

- objects to the granting of a permit on specified grounds.

The floodplain management authority may also provide any other advice which it believes is relevant to the application and may assist the council in reaching its decision.

The Planning and Environment Act categorises referral authorities as either determining or recommending. If the floodplain management authority is a determining referral authority the council must refuse a permit, if this is the decision of the referral authority, or include its conditions of permit. A referral authority cannot direct a council to issue a permit.

In contrast, the council must consider a recommending referral authority's advice but is not obliged to refuse the application or to include any recommended conditions.

Request for more information

A council can require the applicant to provide more information about a proposal, either for itself or for a referral authority. A failure to provide this information can result in a planning permit application lapsing. An application that has lapsed cannot be recommenced.

Notice of application

The requirements for giving notice of an application are set out in section 52(1) of the Planning and Environment Act. This allows those potentially affected by the proposal to have the opportunity to make submissions or objections.

Floodplain management authorities may receive section 52 notices if the planning scheme does not list them as a referral authority. For example, the land may be flood affected but not identified in a flood zone of flood overlay.

Councils are responsible for giving notice of the application, or for requiring the applicant to give notice. It may involve a personal notice to owners and occupiers of nearby land, a notice in newspapers and signs placed on the site.

Council decides

After considering the proposal in relation to the requirements of the planning scheme, advice from the referral authorities and objections and

submissions from those notified, the council makes its decision:

- If the council decides not to grant a permit it issues a Notice of Refusal.
- If the council decides to grant a permit and there were non-trivial objections, or if a condition proposed by a recommending referral authority is not included on the permit, it issues a Notice of Decision. If there are no requests for VCAT to review the decision within the prescribed time council issues a planning permit.
- If the council decides to grant a permit and there were no objections, it issues a planning permit.

What happens next

If an application for a permit is refused, the applicant can apply to VCAT for a review of the Notice of Refusal.

If a Notice of Decision to grant a permit is issued, objectors and recommending referral authorities can apply to VCAT for a review. A recommending referral authority can also appeal a Decision not to include a condition on a permit it requested.

These and other appeal provisions are described in Chapter 5 of *Using Victoria's Planning System*. They include a request to review a condition in the permit, and an application to cancel or amend a permit.

Depending on the outcome of the review, a planning permit may be refused, altered, or accepted.

Further guidance

More information is available through Planning Practice Note 11 (*Applying for a planning permit under the flood provisions*).



Part Three - assessing development proposals

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7. Overview

Floodplain managers assess development proposals against four key objectives. Criteria have been developed to assess the impacts.

The development guidelines consider four objectives for demonstrating compliance.

Objective 1 – Safety:

Protect human life and health and provide safety from flood hazard.

- > Applies to all development proposals.
- > Proposals that are unable to meet the safety objective will be rejected.

Objective 2 – Flood damage:

Minimise flood damage to property and associated infrastructure.

- > Applies to building proposals
- > The objective is usually satisfied by setting floor level requirements as a condition of permit.

Objective 3 – Offsite impacts:

Maintain free passage and temporary storage of floodwaters.

- > Applies to buildings and works in flow conveyance and flood storage areas, including those associated with a subdivision.
- > The objective is usually satisfied by siting the works appropriately.
- > Requirements are reinforced through conditions of permit. Sometimes design modifications are necessary.

Objective 4 – Waterway and floodplain protection:

Protect and enhance the environmental features of waterways and floodplains.

- > Applies to subdivisions, buildings and works near waterways and those parts of the floodplain that are regularly flooded.
- > The objective is usually satisfied by incorporating setbacks, works to prevent harm and appropriate vegetation into site plans.

- > Requirements are reinforced through conditions of permit.

Compliance

The objectives respond to the decision guidelines and other matters in the planning scheme's flood provisions, described in Chapter 5.

All development proposals are to be assessed against the relevant objectives. Assessment is on merits, having regard for the flood risk.

Guiding principles and assessment criteria

Guiding principles for each objective describe what to look for when assessing a planning permit application. For example, when considering life, health and safety (Objective 1), a floodplain manager wants to know if the development is in the most appropriate location, whether the site and access is safe and if there are any hazardous materials.

Each guiding principle has one or more criteria, which are used to establish relevant requirements. Where the development proposal satisfies the relevant criteria, it is deemed to comply with the guiding principle.

Compliance against the guiding principle can be achieved in three ways:

- By setting a condition of permit that is consistent with the relevant criteria, for example, by setting a minimum floor level for a building.
- By requiring a design modification, for example by re-siting a building to a safer location on the site.
- By accepting what is proposed without change. For example, a development proposal might include plans that demonstrate compliance with site safety requirements.

Development having a low net impact

Some proposals can be so minor that there is no appreciable impact on flood risk (e.g. a small back-yard shed). Other proposals may not significantly add to the existing flood risk (e.g. a minor house extension). Usually the assessment criteria will take this into account.

Alternative solutions

A permit applicant may propose an alternative solution. If so, the proposal must demonstrate to the floodplain management authority's satisfaction that the relevant guiding principles and objectives can be achieved.

Solutions should be feasible and not pose a burden on future occupants or impact other properties. For example, a requirement for future occupants to keep open a flow path so that a building can be located over it is not acceptable. Likewise, it would not be appropriate for a flow path to be modified if it affects other properties.

Assessing proposals

Each objective, and the related guiding principles and assessment criteria, are discussed in detail in Chapters 8 to 11. Background information is also given, to assist decision making.

If floodway land has been identified in a planning scheme map, many forms of land use and development will be inappropriate or a prohibited use. This can simplify the assessment process.

Flood affected areas may be used productively when development proposals respond appropriately to the degree of risk. Land uses that promote significant development intensification can change the balance however.

Appendix 2 sets out, in general terms, how the different types of land use align with the four objectives and the associated assessment criteria. For consistency the land use terms in Planning schemes have been used.

The assessment criteria in Appendix 2 will not always be applicable. For example, the waterway protection objective will only be relevant if the proposed development impacts a waterway.



Construction adjacent to a creek in Bendigo

Credit: Ian Gauntlett, DELWP

8. Flood safety

When considering the risk to life, health and safety, a key determinant is when flood depths and flow velocities become unsafe. If a site or access is unsafe a planning permit will be rejected. If hazardous materials are present, they must be managed.

The most common cause of flood-related deaths is people drowning in their own properties, or when travelling to or from their properties. Less common causes of death are heart attacks and electrocutions.

Buildings and their foundations can be made safer through good design. It is not so easy to prevent cars, bikes or people attempting to move through floodwater to escape its effects.

The flood risk to life, health and safety of any person who will use or access a development includes:

- the effects of isolation and loss of essential services if access is cut off
- the danger to occupants of the development, other floodplain residents and emergency personnel.

Flood safety can be compromised if hazardous chemicals leach into the water. The Planning Policy Framework in planning schemes requires strategies to avoid contamination.

All development proposals must address Objective One.

Objective One: Protect human life and health, and provide safety from flood hazard

Guiding principle	Assessment criteria
Site and access safety must not be compromised	1.1. Depth and flow. Development should not be allowed on properties where the depth and flow of floodwaters would be hazardous to people or vehicles entering and leaving the properties. See Tables 1, 2 and 3.
Development must be located on sites of lowest overall hazard.	1.2. Siting. Development and access should be located on land with the lowest overall hazard.
Greenfield development sites must be designed to be safe from flood impacts.	1.3. Greenfield development. Greenfield development sites should either be flood free or contain building envelopes filled to the Nominal Flood Protection Level (NFPL - the 1% AEP flood level plus freeboard).
Hazardous materials must not contaminate floodwater.	1.4. Hazardous materials. Developments and uses which involve the storage or disposal of hazardous materials must not be located on floodplains unless the materials are totally isolated from floodwaters.
Vulnerable people must not be exposed to floods and facilities providing vital community or emergency services must be operational during floods.	1.5. Vulnerability. Buildings housing vulnerable people, community services facilities and emergency services should be sited outside the 1% AEP flood extent and, where possible, at levels above the height of the probable maximum flood.

Depth and flow

People attempting to enter or leave a property during a flood should not be endangered by deep or fast-flowing water. This includes emergency response personnel, property occupants and visitors.

The areas of most interest are:

- around building envelopes
- at entrance and exit points to buildings
- along driveways and internal connecting routes to outbuildings and car parking

- along external connecting routes leading to safety.

Buildings and their foundations must also be safe from collapse or erosion.

The depth and velocity of floodwaters are key determinants of flood safety. Table 1 shows the thresholds applying for the three categories.

Note that Table 1 does not apply to vulnerable community members such as infants and the elderly.

Table 1: Thresholds for safety of children, small cars and light buildings

Source: Adapted from *Australian Rainfall and Runoff*

Category	Maximum depth (D), velocity (V) and product (VD)		
	D max metres	Vmax Metres/second	VD max Metres ² /second
Children	0.5	3.0	0.4
Small cars	0.3	3.0	0.3
Light buildings	2.0	2.0	1.0

For still water situations, small cars can become buoyant at flood depths of 0.3 metres. Children (but not infants) are able to safely wade in depths of 0.5 metres. Lightly constructed buildings, such as dwellings, can safely withstand depths of flooding of 2 metres.

When flow velocities are high, lower depths apply. A maximum flow velocity of 2 metres per second has been adopted for site and access safety for all development proposals. This is considered the upper limit for lightly constructed buildings in *Australian Rainfall and Runoff*.

Note that the “deemed to satisfy” provisions of the building standard, *Construction of buildings in flood hazard areas*, applies a lower limit of 1.5 metres per second for the buildings subject to this standard. For

higher velocities the building regulators require the buildings to be designed to withstand the forces from flood impacts.

All proposed development should satisfy the safety requirements specified in Tables 2 and 3. They are based on three categories:

- Building stability for residential development and other lightly constructed buildings.
- The safety of small children evacuating on foot.
- The stability of small cars being driven through floodwater.

The information in the tables considers research into flood behaviour on vehicles, people and buildings from *Australian Rainfall and Runoff*.

Table 2: Safety criteria for subdivision of land

Type	Maximum depth (D), velocity (V) and product (VD)			Applicable to
	D max metres	V max metres/second	VD max metres ² /sec	
Greenfield residential	0.3	2.0	0.3	Entrance to lots and accessway
Other residential	0.3	2.0	0.3	Lots (including entrance) and accessway
Commercial or industrial	0.5	2.0	0.4	Lots (including entrance) and accessway
Agricultural, if it involves a proposal to construct a new dwelling	0.5	2.0	0.4	Entrance to lots

Table 3: Safety criteria for development other than subdivisions

If a building or works are not specified in the table, use a category that is similar, considering the scale, purpose and risk to future occupants.

Type	Maximum depth (D), velocity (V) and product (VD)		
	D max metres	V max metres/second	VD max metres ² /second
Accommodation			
New single dwelling on vacant block	0.5	2.0	0.4
Replacement dwelling - less than 20 square metres increase in footprint	n/a	n/a	n/a
Replacement dwelling - more than 20 square metres increase in footprint	0.5	2.0	0.4
Dwelling extensions less than 20 square metres	n/a	n/a	n/a
Dwelling extensions greater than 20 square metres	0.5	2.0	0.4
Additional dwelling	0.3	2.0	0.3
Dependent person's unit			
Group accommodation			
Residential building			
Residential village			
Retirement village			
Basement			
Camping and caravan park:			
• Permanent sites	0.3	2.0	0.3
• Temporary sites where caravans can be quickly evacuated	n/a	n/a	n/a
• Other sites	0.5	2.0	0.4

Type	Maximum depth (D), velocity (V) and product (VD)		
	D max metres	V max metres/second	VD max metres ² /second
Non-accommodation buildings, other than for an agricultural use or associated with car parking, outbuildings, sheds or carparking. Includes child care and education, industry, office, place of assembly, retail & warehouse			
Industrial building, office, place of assembly, retail building, or warehouse	0.5	2.0	0.4
Child care or education building (other than schools)	0.3	2.0	0.3
Replacement buildings or expansions – less than 130% of the original footprint	n/a	n/a	n/a
Replacement buildings or expansions – more than 130% of the original footprint	0.5	2.0	0.4
Agricultural buildings			
Buildings associated with grazing, crop raising and animal husbandry, including animal keeping, animal training and animal production. Excludes sheds and outbuildings	0.5	2.0	0.4
Sheds and outbuildings less than 40 square metres	n/a	n/a	n/a
Sheds and outbuildings greater than 40 square metres	0.5	2.0	0.4
Sheds and outbuildings (other than agricultural buildings) and car parking			
Shed used for domestic purposes	n/a	n/a	n/a
Carports, garages and non-domestic sheds associated with urban and low-density residential development	0.5	2.0	0.4
Replacement carports, garages, sheds and outbuildings	n/a	n/a	n/a
Non-domestic carpark enclosed by walls or similar barrier	0.5	2.0	0.4
Open air carpark without walls	0.5	2.0	0.4

Siting

It makes good sense to locate a building or building site on the highest available ground. However, access must also be considered. Low-level access can increase the evacuation risk to future occupants of the property. Locating development on land with the lowest overall flood hazard reduces exposure to the hazard.

Greenfield development

Greenfield development sites can increase the number of people exposed to a flood hazard. For safety reasons, the subdivided sites should be flood free. Depending on the scale of the development and the impact of fill on flood behaviour, this may not always be possible. The floodplain management authority may therefore agree to restrict fill to

building envelopes in some instances. The accessway should be within the site safety criteria specified in Table 2.

Hazardous materials

Developments and uses can involve the storage or disposal of environmentally hazardous chemicals and wastes. The sources of such material include agricultural, industrial and sewage treatment uses.

Exposure to these materials can lead to serious contamination. The potential contact between such substances and floodwaters should be considered as part of the design of the building. Materials that could become pollutants should be stored above the NFPL. Some councils and floodplain management authorities may require storage above larger floods, such as the 0.5 per cent AEP flood.

Vulnerability

Some services need to function continuously and should be located outside the 1% AEP flood extent, and preferably above the Probable Maximum Flood. They include hospitals, ambulance stations, police stations, fire stations, transport or communications facilities, community shelters and schools. This is referenced in the Planning Policy Framework in planning schemes.

Buildings housing vulnerable people, including dependent persons' units and residential villages, should also be located outside the 1% AEP flood

extent. Vulnerable people are defined in the glossary.

Where redevelopment is proposed, effort should be made to explore relocation to flood free areas. The applicant should provide evidence of why this has been ruled out, in documentation provided to the floodplain management authority. The applicant should also demonstrate how the flood risk can be reduced, and what contingency arrangements are in place if the site becomes isolated.



Car driving through floodwaters at Bendigo

Credit: North Central Catchment Management Authority

9. Flood damage

Buildings and their contents are susceptible to flood damages. This can result in trauma and economic loss. Raising floor levels, protecting basements and using flood resistant building materials are some options to reduce flood damage.

Buildings that require a planning permit must address Objective Two.

Flood damages

Tangible damages can be quantified, often in dollars. They include direct physical damage to buildings and fittings, and indirect damage arising from the disruption of normal social and economic activities.

Intangible damages are also important, but they cannot be expressed in monetary terms and are often difficult to quantify. They include loss of life, health impacts, loss of ecological values and social trauma. Intangible damages can be reduced if the economic costs of flooding are reduced.

The smaller, more frequent 'nuisance' floods don't usually cause as much damage individually as the larger floods, although the cumulative damage over time can still be significant.

When development occurs in flood affected areas, the flood damage potential must be considered.

Floor levels

Raising floors higher than the flood levels is the easiest way to reduce flood damage. When floors are overtopped valuable contents such as carpets, furniture, electrical appliances and furnishings are damaged.

When determining a minimum floor level, freeboard is added to the flood level estimate to provide certainty that the floors won't be inundated. The level obtained by adding freeboard to the flood level is called the Nominal Flood Protection Level (NFPL).

The cost or inconvenience of raising the floors of minor buildings or building alterations may need to be weighed against the flood damage prevented.

Freeboard

Freeboard is added to the 1% AEP flood level to provide reasonable certainty of a desired level of service. Floodplain management authorities will apply a range of freeboards, based on their assessment of flood behaviour and uncertainties in flood level estimates.

For a building not requiring a planning permit, the building regulations prescribe a minimum of 300 mm freeboard. The regulations do not apply to a Class 10 building (non-habitable garage, carport or shed), an unenclosed floor area of a building or an extension to an existing building which is less than 20 square metres.

If a planning permit is required, the floodplain management authorities apply a range of freeboard, typically 300 mm to 600 mm, depending on their assessment of flood behaviour. The higher freeboards can be a result of poor reliability of flood information, a steep and narrow catchment (the flood profile is steep), wave action or an allowance for long-term climatic effects.

Freeboard may be reduced for buildings with a low flood damage potential.

Objective Two: Minimise flood damage to property and associated infrastructure

Guiding Principle	Assessment criteria
Buildings must not interfere with existing or proposed water, sewer or drainage services. (Applies to Melbourne Water or council).	2.1. Water services. Buildings and building envelopes should be located sufficiently away from a water, sewer or drainage asset to enable that asset to be serviced.
Buildings must be designed to avoid significant financial impacts of flood damage.	2.2. Floor levels. The floor levels of buildings should be set in accordance with Tables 4 to 6.
The basements of any new buildings must not flood.	2.3. Basements. Basements should be designed to be protected from flooding.
Those parts of buildings affected by flooding must be able to withstand the effects of inundation.	2.4. Materials. Any building or portion of a building below the 1% AEP flood level should be constructed from flood-resistant materials.
Services to a building must be capable of functioning during and after a flood.	2.5. Building services. Essential services to a building should be flood proofed or raised above the NFPL.

Water services

Melbourne Water and councils manage an extensive network of pipes and other infrastructure. Most, but not all, are on land owned or managed by Melbourne Water and the councils. Adequate distances between a building and the water service are required to protect the assets and to avoid encroachment. Formal approval is required from Melbourne Water to build, develop and renovate property on or near Melbourne Water assets.

Floor levels

Minimum floor levels for buildings are specified in Tables 4 to 6. This enables tangible flood damages to buildings and their contents to be avoided or reduced. Freeboard requirements are relaxed for minor development:

- where the flood damage potential is likely to be low
- where the cost and inconvenience of raising floors for building extensions is disproportionate to the benefits.

As it is not possible to foresee all circumstances, floodplain management authorities have discretion to relax floor level requirements, if appropriate, after considering:

- the building's purpose and flood damage potential
- how the flood damage potential can be kept as low as reasonably practical, e.g. by requiring storage areas above this level or locating a building to the highest feasible part of the site
- the ability of a future occupant to recover from a flood.

Basements

This criterion applies to buildings with basements, and associated lifts, vents and drainage systems. To avoid floodwaters entering the basement, all entry points should be protected. Entry to basements should incorporate a continuous apex (or crest) that is at the NFPL or higher.

Table 4: Floor level requirements

If a building is not specified in the table, use a category that is similar, considering the scale, purpose and risk to future occupants

Type	Minimum floor level
New or replacement dwelling	NFPL
Dwelling extensions	As specified in Tables 5 and 6
Dependent person's unit	NFPL
Host farm	
Group accommodation	
Residential building	
Residential village	
Retirement village	
Basement	
Permanent caravans or cabins	NFPL
Industrial building, office, place of assembly, retail building, or warehouse	NFPL
Child care or education building	NFPL
Leisure and recreation building	NFPL
Replacement buildings or expansions	NFPL
Buildings associated with grazing, crop raising and animal husbandry, including animal keeping, animal training and animal production. Excludes sheds and outbuildings	NFPL
Shed less than 20 square metres	None
Shed between 20 and 40 square metres	1% AEP flood level
Shed larger than 40 square metres	NFPL
Garage	1% AEP flood level
Carpark without walls	None

Table 5: Floor level requirements for dwelling extensions with existing floor levels below the 1% AEP flood level

Size of extension	If the difference between the 1% AEP flood level and the existing floor level is:	
	300 mm or more	Between 0 and 300 mm
	Set the floor level of the extension at:	
Up to 20 m ²	Existing floor level	Existing floor level
20 to 40 m ²	NFPL	Existing floor level
Greater than 40 m ²	NFPL	NFPL

Table 6: Floor level requirements for dwelling extensions with existing floor levels above the 1% AEP floor level

Size of extension	If the existing floor level is	
	Between the 1% AEP and the NFPL	Above the NFPL
	Set the minimal floor level of the extension at	
Up to 20 m ²	Existing floor level	Existing floor level
20 to 40 m ²	Existing floor level	Existing floor level
40 to 80 m ²	Existing floor level	Existing floor level
Greater than 80 m ²	NFPL	Existing floor level

Materials

Any building or portion of a building below the 1% AEP flood level should be constructed from flood-resistant materials. Floodplain management authorities may specify a condition of permit to this effect.

Some materials are not resilient to flooding. Waterlogging can reduce the strength of timber or cause warping. Plasterboard, insulation and heating ducts may require replacing after a flood and building cavities can fill with silt.

Floodplain management authorities may require those parts of a building to be constructed of flood resistant material to minimise flood damage. They are not building regulators and cannot advise on the choice of building materials.

Building services

Essential services are associated with the supply of electricity, gas, power, telecommunications, water supply, drainage and sewage. Apart from safety and contamination issues, they can be costly to repair or replace. Constructing new buildings or redeveloping old buildings provides an opportunity for essential services to function during floods. They are required to be flood proofed or raised above the NFPL.



Flood damages at Bridgewater, Jan 2011.

Credit: Rob Scholes, Bridgewater resident

10. Flood impacts

Development in flood affected areas can affect flow conveyance and flood storage. This causes flood levels and flow velocities to increase and may divert floodwater onto other land. Careful consideration to the location and alignment of buildings and the placement of fill can reduce the impacts.

Floodplains temporarily store floodwaters and allow for the passage of flood peaks downstream. The conveyance and storage functions of floodplains and flow paths interact to control the timing, duration and level of flooding at a site.

Works within the floodplain can alter flood behaviour by:

- Diverting flows to areas of land not previously subject to flooding.
- Constricting the passage of flows passing through the site along the river channel or flow path. This causes flood levels and flow velocities to rise at and upstream of the site.

- Reducing the volume of temporary storage within the floodplain. This results in a more rapid passage of floodwaters and an increase in peak flow in downstream reaches. Increasing the flow increases flood levels and flow velocities.

Reducing the effectiveness of flood conveyance or flood storage areas increases the risk of property damage to third parties. Important considerations are:

- The effect of increased flood depths and flow velocities. Freeboard for adjacent areas could be reduced. Erosion could be more prevalent. The area flooded could increase.
- The effect of flow diversions. There may be a change in flow direction.
- The cumulative impacts of lost flood storage.

The floodplain management authority will need to consider how sensitive the flow conveyance or flood storage areas are in relation to development. This will vary with location.

Earthworks, buildings or any other type of development that has the potential to affect flood storage or flow conveyance, must address Objective Three.

Objective Three: Maintain free passage and temporary storage of floodwaters

Guiding principle	Assessment criteria
The natural function of floodplains and overland flow paths to convey and store floodwater must not be compromised.	3.1. Flow diversion. Development (including earthworks) should not divert floodwaters to the detriment of any adjoining property.
	3.2. Velocity impact. Development (including earthworks) should not increase the flood velocity on any adjoining property
	3.3. Flood level impact. Development (including earthworks) should not increase flood levels on any adjoining properties.
	3.4. Flood storage. Earthworks and buildings should not result in a detrimental loss of flood storage.

Flow diversion

Floodwater will try to find a way around a blockage caused by inappropriately positioned earthworks or a building. This can also change the distribution of floodwater, which affects adjoining properties.

Floodplain managers will therefore look at the potential consequences of flow diversions when assessing development proposals. For example,

drainage patterns may be altered because of the filling of land or obstructions.

Velocity impact

Obstructing flow paths will cause flow velocities near the obstruction to increase during a flood. This can result in scouring as floodwaters try and find a way around the obstruction, increasing the amount of sediment and debris downstream. It can also affect site safety.

Buildings or works that significantly obstruct flows should be realigned or moved away from the flow path. Replacement buildings should be designed so that their footprints are no larger than the original building.

Flood level impact

Obstructing flow paths will also increase flood levels locally, increasing the area flooded and increasing the amount of flood damage, particularly if above floor flooding occurs. Increases in flood levels can be avoided by reducing the amount of obstruction in flow paths.

Flood storage

Large buildings (relative to the size of the floodplain or overland flow path) reduce flood storage, as does landfill. Reducing flood storage can change flood behaviour. Floodplain managers will seek to minimise the amount of fill, reduce a building's footprint or require construction on elevated footings in preference to slabs on the ground.

Flow conveyance

Flow conveyance can be adversely affected by changes to the cross-sectional flow area, grade or alignment of the flow path. This increases flood levels and flow velocities. Not interfering with existing flow paths will minimise a development's impact on flow conveyance (see Figure 3).

Increases in flow velocity and the flood level are influenced by the size of the obstruction relative to the size of the flow path. Mesh fencing and bridges can also have adverse effects. The cumulative effects are important: the more obstructions, the greater the impact.

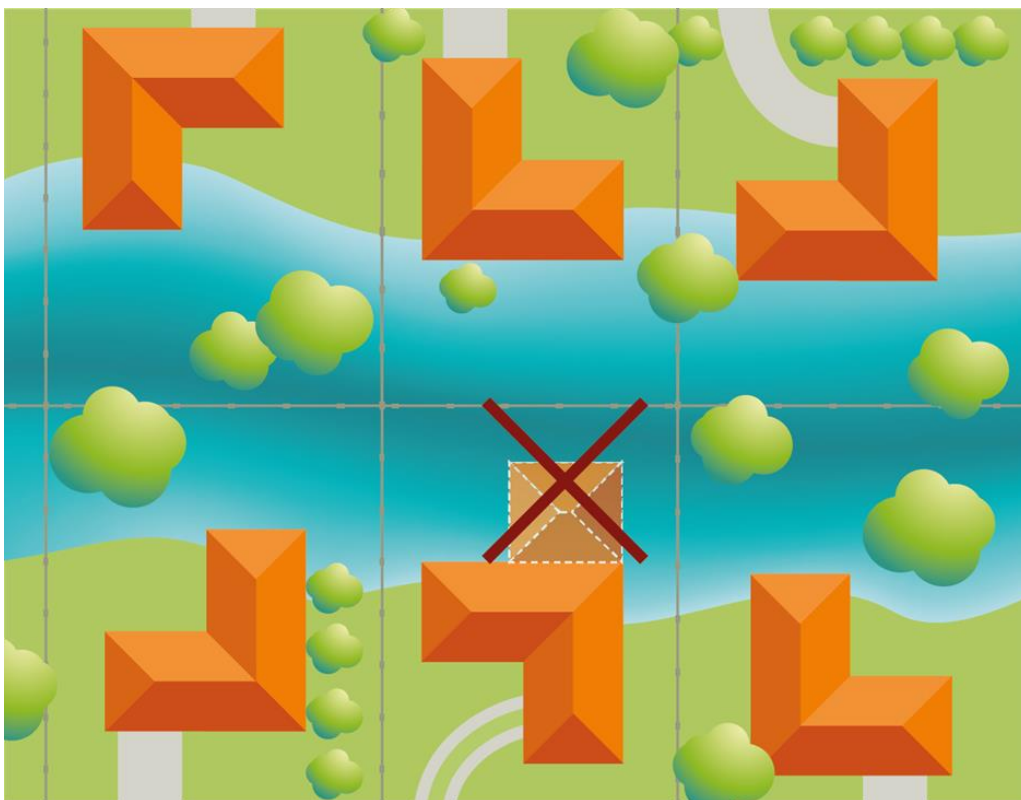


Figure 3: Impacts on flood flows

Flood storage

Flood storage is the volume available to temporarily store water during a flood. It is a natural function of the floodplain and can also be significant in areas subject to overland flooding.

The temporary storage of floodwaters commences before the peak of the flood event. It reduces the peak flow rate at and downstream of the storage area, delays its arrival and reduces the size of the flood.

Reducing flood storage can change flood behaviour at the site and other properties (see Figure 4). This affects flood levels, flow velocities, how long flood waters are around for and how quickly floodwaters rise and fall. As with flow conveyance, the cumulative impacts of proposals that reduce flood storage are important.

Flood storage is reduced by filling of land to raise a property above the flood level. It can also be reduced by the construction of the building itself.

The effect of development depends on the scale of the development relative to the size of the flood storage area. Multiple developments will have a cumulative impact.

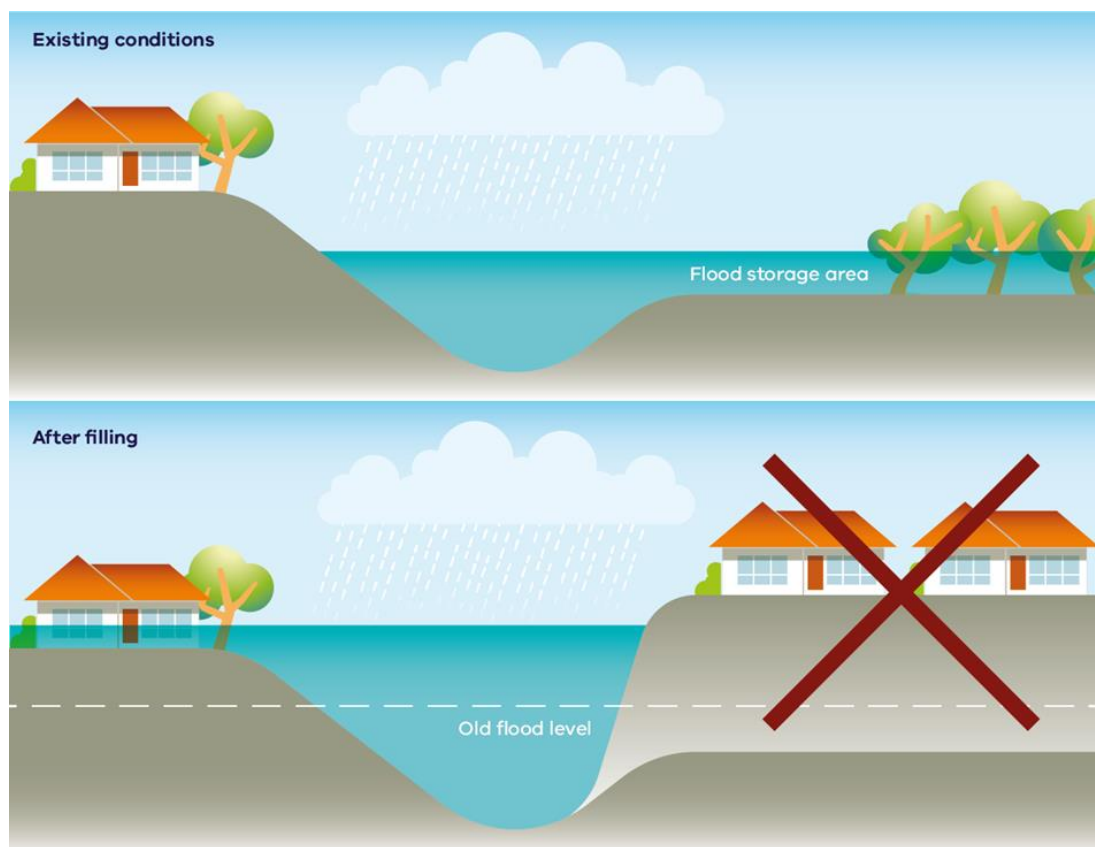


Figure 4: Impacts on flood storage

11. Waterway and floodplain protection

Waterways often have natural environmental values. Floodplain managers will examine development proposals for their potential impact, to preserve or enhance these values.

Waterways are rivers and streams, those parts of estuaries and floodplains that are associated with them (including floodplain wetlands) and non-riverine wetlands. A more comprehensive definition is given in the Water Act.

Protecting the form and function of waterways, particularly riparian corridors and those parts of the floodplain that are regularly flooded, also protects their benefits. Not least of these is the natural benefit of storing and slowing the progression of floods through catchments and low-lying areas.

Other benefits include:

- providing water to communities
- offering recreational, landscape and amenity values
- improving water quality and filtering nutrients

- preserving stream habitat and wildlife corridors
- providing cultural connectivity to Traditional Owners and Aboriginal Victorians
- replenishing ground water
- reducing erosion of stream banks.

By maintaining or improving waterway and floodplain condition, the values provided can be preserved for both current and future generations.

Works on waterways licences may be required to provide for the protection and enhancement of the environmental qualities of waterways and their instream uses.

Access to an authority's assets

Separate approval may be required from Melbourne Water, Catchment Management Authorities and councils for any connections to, crossing of or work near floodplain management assets, waterways, water supply and drainage assets. This may include bridges, pathways, sewers, jetties and moorings.

Development that has the potential to adversely affect the environmental benefits provided by waterways and floodplains must address Objective Four.

Objective Four: Protect and enhance the environmental features of waterways and floodplains

Guiding principle	Assessment criteria
Development impacting on waterways and floodplains must consider their environmental qualities.	4.1. Waterway and floodplain condition. Development should maintain or improve waterway and floodplain conditions.
	4.2. Access to riparian corridors. Development should allow access to maintain riparian corridors.
	4.3. Water quality. Development should maintain or improve water quality.
	4.4. Natural function. Development should maintain (by avoidance or offset) the natural function of floodplains and waterways in storing and conveying floodwater.
	4.5. Amenity. Development should retain or improve significant vistas or landscapes within the riparian corridor.

While described separately, the five assessment criteria are interlinked. Design plans that show modifications to waterways to compensate for increased runoff, vegetation, the location of paths, etc. will provide a means of ensuring that the assessment criteria are addressed holistically.

The impacts of development can include erosion, altered flood behaviour, loss of habitat, a reduction in water quality and a reduction in species diversity. Site disturbance can create conditions that lead to native vegetation being displaced with weeds and woody debris, such as willows, which choke the waterways.

Waterway and floodplain condition

Waterway condition is an umbrella term for the overall state of key features and processes that underpin functioning ecosystems. They include:

- the number and diversity of species associated with riparian and aquatic flora and fauna, and their habitat and connectivity
- water quality
- the physical form of the waterway, including waterway and bank stability
- waterway environs and continuity of a vegetated corridor
- ecosystem processes such as nutrient recycling and carbon storage.

All forms of development have the potential to negatively impact the condition of waterways or floodplains. For example:

- Stormwater drainage systems can alter the frequency of water flows and cause unnatural flow behaviour and may contain contaminants and pollutants that affects water quality.
- Earthworks can result in loss of wetlands that provide both essential habitat for fauna and flora but also significant natural flood mitigation services by reducing runoff and peak flows.
- Earthworks and building construction can result in vegetation removal, cause increased erosion and pollute waterways.
- Development too close to a waterway can reduce the riparian zone, impede access and reduce amenity values.

If a proposal is located in a Floodway Overlay or Land Subject to Inundation Overlay, the floodplain manager will look at how a development proposal impacts on waterway and floodplain condition. If located in a waterway with natural drainage corridors, the development should support the retention of vegetation corridors, in accordance with the Planning Policy Framework (see Chapter 5).

Access to riparian corridors

Land that adjoins rivers, creeks, estuaries, lakes and wetlands is known as riparian land (often called 'frontage'). Riparian land can vary in width from a narrow strip to a wide corridor and is often the only remaining area of remnant vegetation in the landscape. Riparian corridors provide habitat for rare or threatened species, connecting larger patches of

remnant vegetation and a corridor for the movement of animals and native plants.

Riparian land is valued for recreational activities and tourism. It also provides sites of significance to Aboriginal people.

Paths and waterway access can be incorporated alongside waterways for maintenance and recreational access. The two functions can often be combined. Sometimes councils may have requirements for recreational trails or shared paths.

Water quality

Water quality can be affected if development occurs. Several requirements are specified in planning schemes for stormwater management and integrated water management (e.g. Clause 56.07 of planning schemes). Floodplain managers may specify conditions of permit that are consistent with these requirements. For example:

- Establishing waterway corridors and paying close attention to drainage discharge points allow for surface runoff to be filtered.
- Designing waterway features to reduce stagnation will discourage algal blooms and mosquito infestation.

Natural function

Urban development results in significant changes to the amount of stormwater runoff into waterways. It is good practice to:

- design and construct drainage features that mimic natural conditions
- maintain flow behaviour to pre-development conditions
- avoid erosion and excessive sedimentation.

Amenity

Past practices of converting minor drainage lines into straight line concrete channels are no longer an appropriate design solution. Constructed waterways, that slow water down, meander, preserve or enhance remnant vegetation and allow public access are preferred.

12. Design responses

In this chapter, general guidance is provided for certain types of development. This is intended to supplement the guidance in Chapters 8 to 11.

Basements

If basements are proposed, the flood risk, site constraints and ease of entry needs to be considered. Access points need to comply with the site safety requirements specified in Table 3 and the ramp must be designed so that vehicles can safely enter and leave the basement. It is good practice for:

- entry and exit points to incorporate a continuous apex set to the NFPL or higher.
- the drainage system to be designed so that external flooding (both above ground and within any piped system) is unable to penetrate the basement area
- vents, staircases, lift wells and any other openings to be designed so that they not act as floodwater inlets to the basement.
- signage to be provided indicating potential to flood in extreme events.

The use of demountable barriers, pumps or other mechanical mechanisms to provide flood protection is not supported because of the risk of malfunction or operational issues.

Buildings

Building materials located below the NFPL can be susceptible to deterioration, corrosion or decay if inundated. This can compromise the safety and function of the building. Factors to consider are the time in contact with floodwater and the time to dry out.

If there are doubts on the structural integrity of those parts of a building below the NFPL, professional advice should be sought.

Buildings with flood affected areas below the ground floor should be free draining and resistant to scour, silt build up and erosion. This reduces clean-up costs.

Enclosures and storage rooms below the NFPL should not be supported as they can often get converted into habitable rooms.

Access to building services (water, sewerage, drainage, etc.) should be preserved by reserves, easements or development setbacks.

Safe access to buildings can often be provided by reshaping land to reduce the depth of flooding near its entrances. To avoid the possibility of cars floating into deeper floodwaters, it may be feasible to include barriers such as trees between the low and high hazard parts of a site.

For building proposals in sensitive flow conveyance or significant flood storage areas, some of the things that could be considered to lessen impacts include:

- using elevated footings in preference to slabs on the ground
- locating or realigning a building to allow for an unobstructed flow path parallel to the direction of the flow
- restricting the size of a building's footprint.

Camping and caravan parks

New permanent caravan or cabin sites have a similar function to house sites in new residential estates, with similar safety issues. If flood-free sites are unavailable, flood emergency plans that provide for safe evacuation are essential.

Carparks

Carparks which are enclosed on all sides by a wall or similar barrier can pose safety risks. Design plans need to demonstrate that car movement can be safely managed, and that people cannot be trapped in a carpark or lift well.

Cut and fill

As noted in Handbook 7, some development proposals will seek to balance fill with compensatory excavation. Flood storage created through excavation will be lost if the excavated area fills with floodwater before the flood peak arrives.

Floodplain managers will need to be satisfied that:

- Flood levels or flow velocities do not increase. A range of floods must be considered.
- The area excavated, and the area filled do not significantly change the cross-sectional area perpendicular to the flow.
- The excavated area is not filled before the arrival of the flood peak.

If the amount of fill is substantial, the developer may be required to provide expert advice. Geotechnical experts must demonstrate that the relevant slopes

are stable and safe, and that filled areas are compacted correctly.

Modelling may be required for large developments. A floodplain manager may require more cut than fill to compensate for uncertainties in flood behaviour.

Fences

Designing a fence in a flow path to be more resistant or resilient to flood debris and high velocities may reduce future flood damage. See *Guidelines for riparian fencing in flood-prone areas*. Open style fencing is encouraged.

Flood protection structures

Permanent or temporary flood walls, flood barriers, levees or other flood protection structures are sometimes proposed for new development. Their purpose is to reduce the costs of new building and infrastructure construction or to make development sites more viable. They are not fail safe and should only be considered for protecting existing development. They should not be used to justify new buildings or roads in unsafe locations or to offset floor level requirements for new buildings.

Greenfield development

Greenfield development involves urban expansion for residential, industrial or commercial purposes (the glossary provides a detailed definition). Proposals need to:

- Consider the hazard over the internal roads and the public roads leading to safety.
- Avoid isolation during floods.
- Avoid situations in which vehicles can be swept into areas of deeper flooding.
- Consider the effect of floods larger than the 1% AEP event. Flow paths that are safe during lesser events may lead to catastrophic flooding for these rarer events.
- Avoid active flow paths and areas downstream from retarding basin overflow paths.

Safe access for infill development

Proponents for infill development or redevelopment usually have no control over the access from the site to safe ground. This can be challenging for communities with a high flood risk. Requiring a shop floor to be built 1.5 metres above the footpath creates access issues for those unable to use stairs, for example.

Proposals that increase the population at risk should follow the requirements for safe access. For

example, subdivision in a residential area should not be supported if the depth and velocities exceed the thresholds in Table 2, because it increases the population affected. Likewise, Table 3 provides restrictions to buildings in unsafe areas: replacement structures and small expansions are acceptable, but not other development.

Wherever possible, the criteria relating to floor level heights should be followed, particularly for dwellings. As can be seen from the example of a shop, there may be instances in which floodplain managers use their discretion to reduce minimal floor level requirements, after considering:

- the scale of the proposal and its purpose
- site constraints
- the amount of flood warning time
- the distance to safe ground.

Where discretion is exercised, a flood emergency plan may be required. The plan sets out appropriate actions to minimise flood damage, risk to occupants, and demands on emergency services.

Subdivisions

To reduce flood conveyance or flood storage impacts, a subdivider may be required to restrict the size of fill pads and specify building envelopes.

Residential subdivision applications are also required to comply with Clause 56 in planning schemes. This includes requirements to manage stormwater.

Sediment and other wastes may need to be filtered before its discharge into waterways, through wetlands, retention basins or other works. Stormwater runoff may also need to be retarded.

Vulnerable people

Vulnerable people depend on others for mobility and basic needs. Wherever possible, buildings for vulnerable people should be located well outside the area affected by the 1% AEP flood.

If this is not possible, the practicality and convenience of community access to significant facilities, such as hospitals, needs to be balanced against the flood risk. Highest priority must be given to the safety of future occupants.

Decision makers need to consider each application on merits, having regard for:

- the scale of the proposal
- its purpose

- the availability of alternate safe sites
- the inconvenience of relocation if an expansion is required
- the community value of the service provided
- the consequences to the community should a proposal be rejected
- the impacts on emergency services
- the effect of isolation.

If it is considered appropriate to support a proposal, increasing freeboard and having an effective emergency management plan in place can help offset safety concerns.

Waterways

It is good practice to improve waterway condition and landscape. Development may affect waterways because of stormwater connections or because it adjoins a waterway. Land use and development proposals should minimise nutrient contributions to waterways and water bodies and the potential for the development of algal blooms.

Existing flow paths and natural floodplain features should be retained in most instances. Development should be sympathetic to the local waterway corridor landscape and seek to improve amenity values. Indigenous riparian vegetation should be used for any revegetation of riparian corridors.

Waterway setbacks

Waterway setbacks, in the form of reserves and easements, provide access to protect and improve waterway condition. They also retain the natural drainage function of waterways, especially ephemeral waterways that have a significant role in flood storage.

In determining an adequate setback, consideration should be given to:

- the condition of the waterway
- its environmental and social values
- the potential for trees or limbs to fall in backyards or on buildings
- the potential for river banks to collapse: this can affect properties outside the 1% AEP flood extent
- Clause 14.02 in the Planning Policy Framework in planning schemes
- whether access is desirable for recreational purposes or to maintain riparian vegetation.

The design of constructed waterways should, wherever practical, mimic the natural stream forms in the immediate region. Two Melbourne Water guidelines are listed in the bibliography.



Evergreen Waters estate, Bendigo

Credit: North Central Catchment Management Authority

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State of Victoria 1987, Planning and Environment Act, <<http://www.legislation.vic.gov.au/>>.

State of Victoria 1988, Subdivision Act, <<http://www.legislation.vic.gov.au/>>

State of Victoria 1989, Water Act, <<http://www.legislation.vic.gov.au/>>.

State of Victoria 1993, Building Act, <<http://www.legislation.vic.gov.au/>>.

State of Victoria 2015, Planning and Environment Regulations, <<http://www.legislation.vic.gov.au/>>

State of Victoria 2017, Climate Change Act, <<http://www.legislation.vic.gov.au/>>

State of Victoria 2018, Building Regulations, <<http://www.legislation.vic.gov.au/>>.

State of Victoria 2018, Marine and Coastal Act, <http://www.legislation.vic.gov.au/>.

Glossary

1% AEP flood: a large flood having a 1% chance of occurring in any given year.

Accessway: a path, route, etc. that provides access to a specific destination or property. This includes legally protected routes through private land and public roads.

Accommodation: Land used to accommodate persons. It includes land associated with the following uses (Victoria Planning Provisions): camping and caravan park, corrective institution, dependent person's unit, dwelling, group accommodation, host farm, residential building, residential village and retirement village.

Adjoining property: All public and private land that is not part of the development site.

Annual Exceedance Probability (AEP): The likelihood of occurrence of a flood of a given size or larger happening in any one year. AEP is usually expressed as a percentage, e.g. 1% AEP.

Assessment criterion: An approach, action, practice or method that permit applicants to demonstrate compliance with the guiding principle.

Average Recurrence Interval (ARI): A statistical estimate of the average number of years between the occurrences of a flood of a given size or larger. The ARI of a flood event gives no indication of when a flood of that size will occur next.

Building envelope: The area on a site where new buildings or extensions to existing buildings are proposed.

Catchment: The area of land draining to a site. It always relates to a specific location and includes the catchment of the main stream and tributary streams.

Coastal flooding: 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.

Community services facilities: Buildings providing services that a community expects to be either resilient to or fully operational during an extreme flood. They include hospitals, residential aged care facilities, community shelters and schools.

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, e.g. activation of seasonal wetlands or depositing of nutrients on agricultural floodplains.

Design flood: The flood selected for design and planning purposes that is used to define the flood zone. In Victoria, for most types of development, this is the 1% AEP flood (or 100 year ARI flood).

Development: The construction or exterior alteration or exterior decoration of a building; the demolition or removal of a building or works; the construction or carrying out of works; the subdivision or consolidation of land, including buildings or airspace; the placing or relocation of a building or works on land; and the construction or putting up for display of signs or hoardings (*Planning and Environment Act, 1987*).

Domestic: Of the home, household.

Emergency services facilities: buildings expected to remain fully functional during floods up to the Probable Maximum Flood. They include ambulance stations, fire stations and police stations.

Essential Services: For these guidelines, means the supply of electricity, gas, power, telecommunications, water supply, drainage or sewerage services

Flood: For these guidelines, the covering of normally dry land by water. The insurance industry considers flooding to be water that has escaped or been released from the normal confines of: (a) a lake, river, creek or other natural watercourse, whether or not altered or modified; or (b) any reservoir, canal, or dam.

Flood affected land: Land inundated by the 1% AEP flood from time to time.

Floodplain: Low-lying land adjoining a waterway (e.g. an open river creek or drainage path) that is covered by water when the river overflows during floods. The extent of the floodplain is defined as the area of land inundated during a Probable Maximum Flood.

Floodplain management authority: In Victoria, a Catchment Management Authority or Melbourne Water.

Floodplain manager: Usually a member of a floodplain management authority, but sometimes a member of a local council. A floodplain manager has

the skills, knowledge and expertise to assess flood behaviour and flood risk.

Flood proofing: 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, sometimes, to reduce contents damage.

Flood-resistant materials: Materials used in building construction that are capable of withstanding direct and prolonged contact with floodwaters without sustaining significant damage.

Flood risk: The potential risk of flooding to people, their social setting and their built and natural environment. The degree of risk varies with the circumstances across a range of flood events, not just the 1% AEP flood.

Flood storage: An area of the floodplain or drainage area important for the temporary storage of floodwater that is later discharged as the flood recedes.

Flow: The rate of flow of water measured in volume per unit time; for example, cubic metres per second (m^3/s). Flow is different from the speed or velocity of flow, which is a measure of how fast the water is moving, for example metres per second (m/s).

Freeboard: The height above the design flood level. It is a factor of safety typically used in relation to the setting of floor levels, apex of underground carpark entrances and so on. Freeboard compensates for a range of factors, including wave action and localised flow effects. It can also compensate for uncertainties in the accuracy of the 1% AEP flood level estimate.

Greenfield development: For these guidelines, greenfield development refers to intensification of development of a completely different nature to that associated with the former land use. It can be for a residential, industrial or commercial purpose.

Greenfield development requires major extensions of existing urban services, such as roads, water supply, sewerage and electricity, and can include or lead to detached or semi-detached dwellings in new residential 'estates'. Building sites and access routes need to be kept safe from flooding so that the flood risk to future occupants does not intensify. Associated land may require rezoning, or it might be land set aside for urban development without necessarily understanding the flood risk.

Guiding principles: Rules to help a decision maker understand how the relevant objective they are linked to can be applied.

Hazard: An object, situation or event that presents danger to life, health or safety. A flood is considered a hazard because it has the potential to cause damage to people and the community.

Infill development: For these guidelines, infill development refers to the development of vacant blocks of land within an existing township boundary that are generally surrounded by other developed properties. To avoid confusion, infill development and redevelopment are treated in the same manner in these guidelines.

Inundation: The covering of land by water.

Nominal Flood Protection Level (NFPL): The 1% AEP flood level plus the applicable freeboard.

Objective: The desired outcome to be achieved.

Outbuilding: a building subordinate to but separate from a main building.

Overland flooding: Inundation by local runoff caused by heavier than usual rainfall. It can be the result of local runoff exceeding the capacity of an urban stormwater drainage system or water backing up urban stormwater drainage systems. In rural settings it can also be flow overland on the way to waterways.

Probable Maximum Flood: The largest flood that could conceivably occur at a location. It is usually estimated from the greatest depth of precipitation meteorologically possible for that location, coupled with the worst flood-producing catchment conditions.

Redevelopment: For these guidelines, redevelopment means any rebuilding or improvements to an existing development on a site that has pre-existing uses (as defined by the relevant zone in the planning scheme). It can include subdivisions.

Redevelopment generally does not require either rezoning or major extensions to urban services, such as roads, water mains, sewer lines or electricity cables.

While redevelopment is often associated with urban communities, it can also include farming-related activities to boost tourism and business, as permitted in the relevant farming and rural activity zone.

Riparian zone: Land that adjoins a river, creek, estuary, lake or wetland.

Riverine flooding: The covering of normally dry land by water that has escaped or been released from: the normal confines of a lake, river, creek or

other natural watercourse (whether or not altered or modified); or a reservoir, canal or dam.

Runoff: The amount of rainfall that is not intercepted, captured or absorbed into the ground during a storm and that subsequently runs along the ground surface. It is also known as rainfall excess.

Planning Policy Framework: The principles, policies and strategies in the Victoria Planning Provisions, for how land is to be used and developed in Victoria. It includes mandatory state-wide components. For example, the State planning policy for floodplain management is to protect life, property and community infrastructure, and to protect areas of environmental significance and river health. The policy requires land affected by a 1% AEP flood to be identified in Planning Scheme maps and for planning decisions to avoid intensifying the impacts of flooding through inappropriately located uses and developments.

Stormwater flooding: overland flooding associated with urban drainage systems.

Storm surge: A rise above the normal sea level along a shore resulting from strong onshore winds and or reduced atmospheric pressure. Storm surges can be formed by intense low-pressure systems.

Subdivision: the division of land into two or more parts which can be disposed of separately (*Subdivision Act 1988*). For these guidelines, subdivision also includes proposals to set aside building envelopes or fill pads.

Waterway: Rivers and streams, their associated estuaries and floodplains (including floodplain wetlands) and non-riverine wetlands.

Victoria Planning Provisions: A comprehensive set of standard planning provisions, including compulsory State policies and strategies, and zones and overlays used locally. They provide a standard format and consistent policies and controls for all Victorian planning schemes.

Vulnerable people: For these guidelines, individuals or groups of individuals who are dependent on more able people for mobility and basic needs. They include the elderly, infirmed, mentally or physically incapacitated, incarcerated and very young children.

Works: Includes any change to the natural or existing condition or topography of land including the removal, destruction or lopping of trees and the removal of vegetation or topsoil.

Acronyms

AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
NFPL	Nominal Flood Protection Level
PMF	Probable Maximum Flood
VCAT	Victorian Civil and Administrative Tribunal

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Appendix 1: Information on flood fatalities

The Bushfire & Natural Hazards Cooperative Research Centre examined the socio-demographic and environmental circumstances surrounding flood fatalities in Australia, between 1900 and 2015. Of the 1859 documented flood fatalities:

- 787 were attempting to cross a bridge, culvert, ford or similar structure
- 77 were attempting to cross floodwaters over normally dry land away from watercourses
- 215 were engaged in an activity near the water (e.g. on the river bank or on a bridge)
- 49 were engaged in an activity in or near a stormwater drain
- 116 were engaged in an activity in the water, such as rescue or swimming
- 93 were engaged in an activity on the water, such as boating
- 226 were engaged in an activity not near a watercourse: this includes 136 in or on a house that was destroyed or severely flooded, and 54 outside a house
- 6 died from other causes
- 290 died from unknown causes.

The CRC research also looked at other factors.

Cause of death

- 54.9% of people were recorded as dying from drowning
- 33.1% of people were likely to have died from drowning or from circumstances that led to drowning (such as exposure and heart attack)
- 3.1% died from other causes such as being hit by flood debris or submerged objects, landslide, vehicle accidents, falling tree limbs, shock, collapse or electrocution
- 8.9% died from unknown causes or were missing and presumed dead.

Flood awareness:

- 12.8% were aware of the flood but did not expect to encounter it (e.g. walking their dog on the riverbank)
- 43.6% were aware, but the depth, speed and / or debris took them by surprise
- 13.2% were unaware and taken by surprise
- 15.5% were children less than 11 years old (limited understanding, or a parent made the choice)
- the awareness of the remaining 14.9% was unknown.

Flood type

- 71.3% of fatalities occurred near the coast. Most were associated with short duration riverine flooding with little or no flood warning.
- 15.9% of deaths occurred along inland rivers (extensive, slow moving flooding)
- 7.6% occurred in an urban setting (stormwater flooding).

Flood severity

- 33.8% of fatalities occurred in a minor/moderate flood
- 13.1% occurred in a major flood
- 22.7% associated with a severe or record flood
- for the remainder, the link to flood severity was unknown.

Death rates have steadily declined over the years. Looking at a more recent time, from 2000 to 2015, there were 178 deaths: 16 of these in Victoria.

- 53.4% (95 people) died while attempting to cross a watercourse
- 11.2% (20 people) died in an activity not near a normal watercourse
- 48.3% (86 people) were in a vehicle at time of death
- 25.3% (45 people) were on foot.

Appendix 2: Specific development requirements

Development type	Assessment criteria for the following objectives			
	Flood safety	Flood damage	Flood function	Waterway protection
Subdivisions				
Subdivisions that provide for earthworks	1.1 - 1.3	2.1	3.1 - 3.4	4.1 - 4.4
All other subdivisions	1.1 - 1.3	2.1	3.1 - 3.4	4.1 - 4.4
Accommodation building other than minor buildings and works				
Dwelling or dependent persons unit	1.1 - 1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Dwelling extension	1.1 - 1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Extensions to an accommodation building other than a dwelling	1.1 - 1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Retirement village	1.1, 1.2 & 1.5	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Residential building: E.g. backpacker's lodge, boarding house, hostel, nurses' home, residential aged care facility, residential aged care facility, residential college, residential hotel	1.1, 1.2 & 1.5	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Camping and caravan park: permanent buildings, permanent caravans and permanent cabins	1.1 - 1.2	2.1, 2.2, 2.4 & 2.5	3.1 - 3.4	4.1 - 4.4
Camping and caravan park - temporary accommodation sites where sites can be quickly evacuated	Nil	Nil	Nil	4.1 - 4.4
Agriculture				
Buildings associated with grazing, crop raising and animal husbandry, including animal keeping, animal training and animal production	1.1, 1.2 & 1.4	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Child care and education				
Child care centre	1.1, 1.2 & 1.5	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Education centre (other than schools)	1.1, 1.2 & 1.5	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Industry				
Research and development centre	1.1, 1.2 & 1.4	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Rural industry	1.1, 1.2 & 1.4	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Service industry	1.1, 1.2 & 1.4	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Office				
E.g. bank, electoral office, medical centre, real estate agency, travel agency	1.1 - 1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Place of assembly				
Exhibition centre, function centre, nightclub, cinema, library	1.1 - 1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Place of worship, restricted place of assembly	1.1 - 1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4

Development type	Assessment criteria for the following objectives			
	Flood safety	Flood damage	Flood function	Waterway protection
Retail				
Food and drink premises	1.1 - 1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Gambling premises	1.1 - 1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Market	1.1 - 1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Motor vehicle, boat or caravan sales	1.1-1.2 & 1.4	2.1 – 2.5	3.1 - 3.4	4.1 - 4.4
Shop	1.1-1.2 & 1.4	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Hardware, trade, agricultural supplies	1.1, 1.2 & 1.4	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Warehouse				
Commercial display area	1.1-1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Mail centre	1.1-1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Store	1.1-1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Car parking, outbuildings and works				
Non-domestic carpark enclosed by walls	1.1-1.2	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4
Open air carpark not attached to a dwelling or residential building	1.1-1.2	Nil	Nil	4.1 - 4.4
Outbuilding (including a shed) less than 20 square metres	1.2	2.1, 2.2 & 2.4	3.1 - 3.4	4.1 - 4.4
Outbuilding greater than 20 square metres	1.1, 1.2 & 1.4	2.1, 2.2, 2.4 & 2.5	3.1 - 3.4	4.1 - 4.4
Carport	1.1, 1.2	2.1, 2.4	3.1-3.4	4.1-4.4
Small flood-protection levee around immediate curtilage of existing rural dwelling or other rural building	Nil	2.1	3.1 - 3.4	4.1 - 4.4
Earthworks not associated with a development type listed above	Nil	2.1	3.1 - 3.4	4.1 - 4.4
Fencing	Nil	Nil	3.1 - 3.3	4.1 - 4.4
Emergency and community service facilities				
Emergency and community services facilities, including hospitals, ambulance stations, fire stations, police stations, residential aged care facilities, community shelters and schools	1.1, 1.2, 1.4 & 1.5	2.1 - 2.5	3.1 - 3.4	4.1 - 4.4

Notes

1. If a proposed building or works are not specified in the table, use a category that is similar, considering the scale, purpose and risk to future occupants.

2. The assessment criteria listed won't apply for all circumstances. Assess against the net increase in risk, considering the population exposed to flooding, the vulnerability of occupants and the relevance of the guiding principles.

