Flood Facts

Australia has an extremely variable climate. Throughout its long history, the flood-drought cycle has been an unavoidable and natural part of life, with periods of severe drought followed by extensive flooding.

We cannot stop floods; there will always be a residual risk of flooding in the future. However, we can manage this risk through a combination of measures including: applying and communicating lessons learned from past floods; improving land use planning and floodplain management; using improved knowledge and technology to enhance flood forecasting and warnings; and adopting smarter urban design and integrated water management.

Floods and their consequences

What is a flood?

A flood is an event where water inundates land that is normally dry. Floods are a natural process that can be caused by a number of factors and affected by human activities. Floods occur at irregular intervals and no two floods are the same.

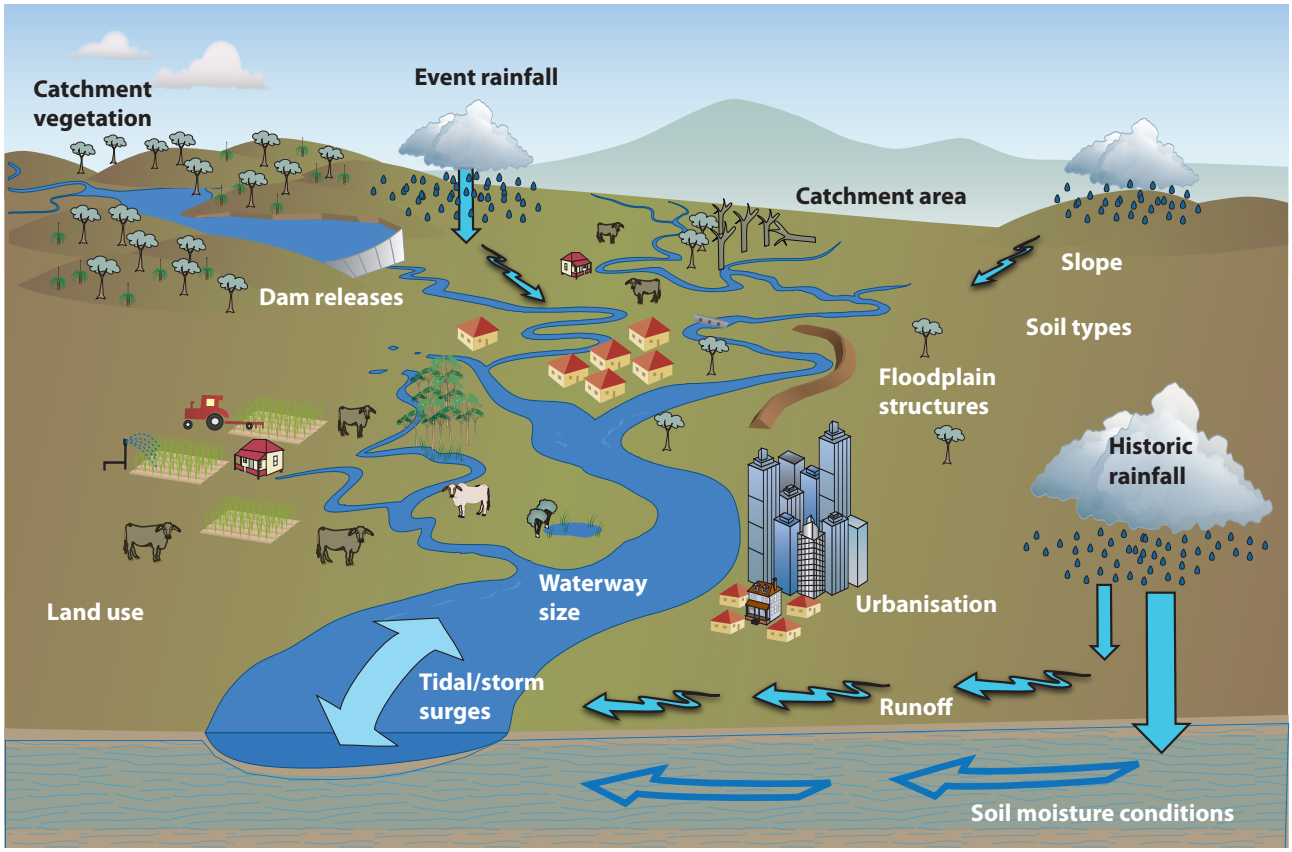
Floods can occur suddenly
Sudden, heavy and intense rainfall can cause floods to quickly rise in the minutes or hours that follow. These are known as flash floods and are typically associated with relatively small catchment areas.

Floods can occur slowly
In large catchment areas, rainfall can build up over hours, days or weeks. The runoff from this rainfall may create significant floods that inundate large areas of land for days, weeks or months.

What factors contribute to floods?

While many factors contribute to floods, the main cause of floods in Australia is rainfall. Australian rainfall is highly variable compared with other parts of the world. This is due in part to the El Niño – Southern Oscillation.

When rain falls over a catchment, some rainfall is 'captured' by soil, vegetation and water storages such as farm dams. The remainder flows downhill into waterways. The amount and speed of rainwater that reaches the waterways is dependent on the characteristics of the catchment, particularly its size, shape, vegetation, the way the land is used and the preceding weather conditions. Other factors that affect flooding are illustrated below.



An illustration of factors that contribute to floods. *This conceptual diagram was developed using the Integration and Application Network tool.*

How floods vary in severity

- **The flood volume** (the total amount of water in the flood): this contributes to both the level and duration of flooding. Dams and detention basins are less effective at flood mitigation during large volume floods.
- **The rate of rise** (how fast the flood rises): a flood that rises quickly provides less time for warning and evacuation.
- **The flow velocity** (how fast the water is flowing): faster flow causes a higher risk to human life, a higher risk of erosion, and more damage to infrastructure.
- **The flood duration:** a flood that lasts for a longer time can have a greater impact due to the increased duration of the disruption to transport, business and personal networks.
- **The areal extent** of flooding: flooding that affects a larger area often has a greater impact.

Measuring flood magnitude

The magnitude (or size) of a flood event can be expressed in many ways, but the peak level of the water at a particular location in a waterway is the most unambiguous and easy to measure. This is measured by a river gauging station. The Bureau of Meteorology classifies floods based on three categories related to water level:

- ***Major***: This causes inundation of large areas, isolating towns and cities. Major disruptions occur to road and rail links. Evacuation of many houses and business premises may be required. In rural areas, widespread flooding of farmland is likely.
- ***Moderate***: This causes the inundation of low lying areas requiring the removal of stock and/or the evacuation of some houses. Main traffic bridges may be closed by floodwaters.
- ***Minor:*** This causes inconvenience such as closing of minor roads and the submergence of low-level bridges.

What are the consequences of floods?

Floods impact on individuals and communities, and have social, economic, and environmental consequences. Flood consequences, both negative and positive, vary greatly depending on the location and extent of flooding, and the vulnerability and value of the natural and constructed environments they affect.

Flood consequences can be immediate or long-term and affect:

- individuals
- communities
- businesses
- economies
- infrastructure
- vital services
- tourism
- agriculture
- built and natural environments.

In Australia, floods are the most expensive type of natural disaster, but also one of the most manageable. The average annual cost of floods is $377 million (measured in 2008 Australian dollars). The floods that occurred during the summer of 2010-11 cost the Australian economy an estimated $30 billion.

Improving flood warnings systems and community awareness are among the most cost-effective means to reduce the economic and social losses from floods.

Flood forecasts and warnings

How do we forecast floods?

Seasonal forecasts can alert of a heightened chance of flooding in the coming months. In the shorter term, weather forecasts, together with real-time information on the amount of rainfall that has fallen over a catchment and river water levels, can provide advanced warning of a flood. These forecasts are critical to limit property damage and avoid loss of lives.

The accuracy of weather forecasts varies depending on lead time, the size of the region of interest, the weather variable being forecast, and the latitude of the region. Generally, temperature forecasts are more accurate than rainfall forecasts; the mid-latitudes are easier to forecast than the tropics; and it is generally easier to forecast rainfall over a large area (for example, a large catchment) than local rainfall (for example, a reservoir).

The accuracy of weather and flood forecasts has improved dramatically over the last few decades. However, forecasting river levels and the extent of potential floods is a complex process that is continually being improved.

How do we communicate and warn about floods?

Flood warning systems turn flood forecasts into messages designed to reduce the negative impacts of floods. Improving our warning systems and community awareness of flood risk could reduce losses resulting from floods.

Flood warnings should be:

- **Informative**: they should indicate what the threat is, what action should be taken, by whom and when, and be in understandable, unambiguous and consistent language.
- **Accurate**: as warnings are predictions about the future, there is inevitably some uncertainty. Warnings need to be carefully constructed and worded so they are easily understood.
- **Timely**: warnings need to allow enough time for appropriate action. This is particularly challenging for flash floods.
- **Trustworthy**: warnings are more likely to be heeded if they come from multiple trusted sources.
- **Targeted to appropriate audiences**: warnings need to cater for many sub-groups, each with its own needs and expectations, preferred way of receiving warnings, and own ways of interpreting messages. No one warning source will reach, or be understood by, everyone.

Land use planning should consider the chance of a flood and its potential impacts.

- **Reliable**: warnings need to work under extreme conditions (for example, in inundated areas, in the absence of electricity), as this is when warnings are most needed. A variety of warning sources increases the likelihood that warnings will be heard.

Managing floods

How do we estimate the chance of a flood occurring?

Understanding the chance of floods occurring is important for managing flood risk. The chance of a flood of a particular size can be estimated using statistical analysis of long-term flood records (known as flood frequency analysis) or statistical analysis of rainfall records together with computer models (known as rainfall-based techniques).

Computer models known as floodplain hydraulic models can translate these predictions into expected flood levels for different areas. There will always be some variation between actual flood events and the predictions made by floodplain hydraulic models.

The chance of a flood event can be described using a variety of terms, but the preferred method is the Annual Exceedance Probability (AEP). A flood with a one per cent AEP has a one in one hundred chance of being exceeded in any year, whereas a flood with a 10 per cent AEP has a one in ten chance of being exceeded in any year, and so on.

Currently, the one per cent AEP event is deemed as having an 'acceptable' risk for planning purposes throughout most of Australia. However, good planning needs to consider both the chance of a flood (that is, the AEP) and the potential negative consequences of a flood occurring in a particular location. Refer to the illustration above.

The Probable Maximum Flood (PMF) is an estimation of the largest possible flood that could occur at a particular location.

How do we manage flood risks?

Flood risk includes both the chance of an event taking place and its potential impact.

In new development areas, land use planning informed by floodplain management plans can reduce flood risk. Measures might include restricting the location of development (using zonings) and placing conditions on development (for example, building codes).

Flood risk is harder to manage in existing developed areas. However, flood modification measures such as dams or levees can change the behaviour of floodwaters. Property modification measures such as land filling, flood proofing buildings, house raising, and building removal or relocation can also protect individual buildings against floods.

Response modification measures such as flood warnings, upgrading flood evacuation routes, flood evacuation planning, flood emergency responses, and flood education programs help communities deal with the residual risk of floods.

What does the future look like?

The future is likely to see an increase in flood risk due to climate change, population growth and urbanisation. However, we can manage our flood risk.

The following measures are vital to improve our flood preparedness now, and in the future: better land use planning and floodplain management; improved flood forecasting and warning technologies and systems; smarter urban design; integrated water management; and better communication, community awareness and engagement.

Further information

For further information on floods, to read the Understanding floods: Questions & Answers report, or to test your flood knowledge, visit www.chiefscientist.qld.gov.au/floods.