

# **FLOODPLAIN PROTECTION GUIDELINES**

**PLANNING AND LAND MANAGEMENT**

**DEPARTMENT OF URBAN SERVICES**

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# **1 Background**

## **1.1 Nature of floods and floodplains**

Floods are a natural component of the hydrological cycle. Flooding, defined as the inundation of land which is not normally covered by water, occurs when the channel of a river or creek is unable to contain the volume of water flowing from its catchment. At these times the river and its associated floodplain form an integrated system for the passage of flood flows.

Flooding, is the primary process which governs the nature of a floodplain including its physical form, environmental character and ecology. Floods may have a significant effect on the survival of natural flora and fauna on floodplains.

Flooding of inland areas typically depends on the intensity, areal distribution and pattern of rainfall and the physical characteristics of a catchment including its topography, land use, soil types and hydrological characteristics.

Floodplains form in response to a range of processes including climatic change, erosion forces arising from floods and the deposition of sediment transported from catchments. Floodplains typically comprise a complex system of ancient channels, alluvium and eroded surfaces.

Floodplains may undergo a variety of geomorphological changes. Changes may be rapid such as adjustments in channel shape when sediment stored in channel benches during a drought is eroded by a flood. Rapid changes in floodplain morphology can also occur when deposition in a floodplain produces a river valley that can no longer accommodate flood flows.

The tracing of the history of the land forms on a floodplain and a knowledge of the age of a land form is necessary if the nature of a floodplain and the likelihood of the continued development or destruction of a floodplain by erosion is to be understood. The stage of development of a floodplain is also reflected in the nature of the land forms encountered, and a variety of floodplain types can be encountered along a river.

As the fringe between land and water based ecosystem, floodplains are a key element in the natural environment due to their support of terrestrial and aquatic communities. The floodplain provides habitats for plant and animal communities, ranging from semi-aquatic communities to those on the margins of the floodplain.

## **1.2 Need for protection of Floodplain functions and values**

Floodplains are valued for a range of reasons; their flat topography, the fertility of their soils, their proximity to water for water supply, transportation and recreation and their support of ecosystems. This range of uses of floodplains can and has led to conflicting demands. In the past unwise development in some areas of Australia has occurred on floodplains, causing damage to floodplain ecosystems, and exacerbating the community damage and disruption caused by floods. There is a need for planning and management strategies to recognise and protect the different functions that floodplains serve.

## **2 Statutory basis for policies and controls for the protection of floodplains**

Under ACT legislation, the Land (Planning and Environment) Act 1991, gives authority to the *Territory Plan*, in which there is an explicit recognition of the need for an integrated approach to land planning. The *Territory Plan* requires that consideration of flood hazard be included in the planning process (Part A2).

Under Commonwealth legislation, there are further requirements to consider floodplains values and functions within the ACT. The ACT (Planning and Land Management) Act 1988 (Commonwealth Act) requires that the *Territory Plan* be not inconsistent with the *National Capital Plan*. The *National Capital Plan* includes specific policies for the protection of the Murrumbidgee River Floodplain:

"Developments and management practices adjacent to the river channel and within the flood plain to be controlled to ensure stability of the channel, river banks and flood plain and to control flooding"

"Extraction of sand and gravel to be considered periodically in reaches where it is deposited, in order to maintain stream channel and flood plain stability, to protect aquatic habitats and recreation areas and to control flooding"

### 3 Purpose of these Guidelines

These guidelines provide a basis for ensuring that development, land uses and management activities in floodplains are in accordance with the principles and policies in the *Territory Plan*.

The process followed in the development of these guidelines was initially to evaluate the functions and values that may be required of floodplains in the ACT (Chapter 4). From these potential functions and values of floodplains, objectives for ACT floodplains in accordance with *Territory Plan* principles and policies have been detailed (Chapter 5). Specific guidelines for the achievement of objectives are to be found in Chapter 6.

The Guidelines will provide a means of evaluating development, land uses and management activities in terms of:

- Permissible land uses and activities within floodplains with respect to maintenance of;
  - Hydrological function
  - Water quality and ecological values
  - Channel shape and stability
- Design and maintenance of infrastructure crossing floodplains
- Controls on extractive industries within floodplains
- Significant environmental values requiring special protection measures

In addition to the role of the Guidelines in relation to land uses and activities on floodplains, they also provide a reference point for floodplain resources data collection and mapping. A thorough understanding of floodplains and their resources is important to the appreciation of the functions and values they can provide, and consequently the objectives required of ACT floodplains. This necessitates an awareness of physical, hydrological, social, economic and ecological characteristics of each designated floodplain. Such information can only be gained by systematically collecting data on these characteristics.

Resource inventorying and mapping should identify all major or significant elements of the floodplain environment including land use, hydrology, water quality, flora and fauna, riverine habitats and aesthetic qualities.

Mapping of flood hazard information derives from an understanding of the hydraulic function, and is a necessary component for appropriate use of floodplains. It is essential in the formulation and implementation of floodplain planning and management to have flood maps at an appropriate scale indicating the extent, intensity and frequency of flooding. A series of 1:10 000 scale flood inundation maps of the ACT have been prepared under the auspices of the ACT Flood Warning Plan to assist authorities and organisations with a role in flood situations, particularly the ACT Police.

Finally these guidelines serve to endorse the establishment and maintenance of flood warning systems, crucial recognition that flood hazard to human life and property exists and needs to be considered in managing floodplains.

## **4 Functions and values of Floodplains**

For the purposes of this document, floodplains need to be delineated. Floodplains are defined in terms of the area inundated by floods with specified return periods. For example the area inundated by the 1 in 100 years floods is the 1 in 100 years floodplain. The flood selected for planning purposes to define the floodplain is known as the flood standard.

The functions and values of floodplains are detailed below and summarised in Table 1.

### **4.1 Flood mitigation**

The action of a flood's passage along a river and floodplain is complex. Floodplains along a river augment the capacity of river channels to discharge floods. The additional flow capacity in floodplains reduces the flood height which would otherwise occur and also reduces flood flow velocities, reducing the potential to destabilise and erode river channels. Floodplains also provide temporary storage of floodwaters, attenuating the peak flood flows and reducing the extent of downstream flooding.

Development or restrictions across flood plains have the potential to diminish the flow capacity of floodplains, increase flow velocities and raise flood levels so that areas formerly not at risk become endangered. Patterns of flow may also change, potentially increasing erosion and damaging services and property.

Flood damage can include tangible and intangible damages. Direct tangible damages arise from the contact of flood waters with a building, motor vehicle, crop, etc. Indirect tangible damages include the costs of excavation and reinstatement, travel restrictions and commercial loss due to loss of trade. Intangible damages include social disruption, inconvenience, isolation and trauma.

### **4.2 Landscape element**

The landscapes of floodplains are distinct and are valued for the diversity of their landscape elements. Floodplain landscapes which have remained in undisturbed states are valuable as nature conservation and interpretation areas. Floodplains that have been modified by past agricultural practices may provide a cultural record of rural land use.

### **4.3 Maintenance of ecosystems**

Floodplains support a range of valuable terrestrial and aquatic ecosystems. The margins of floodplains provide habitats for plant and animal communities specialised to take advantage of this land - water interface.



Identifiable habitats are the littoral zone, wetlands and the riverine terrestrial zone. Littoral habitats include river and creek banks and shallow water margins of lakes and ponds. These support a diverse flora and fauna from both aquatic and terrestrial environments. Wetlands include swamps and marshes and are a key component of floodplains, particularly as fish habitats. The floodplain terrestrial zone includes habitats associated with river and creek banks, lake shores and the margins of ponds and wetlands. Wildlife may use the riverine vegetation for shelter, nesting or feeding, and use the water body for feeding.

Floodplains are also an important component of river corridors, functioning as movement corridors for aquatic and terrestrial species.

#### **4.4 Recreation**

In the ACT, water related recreation is a major component of recreation. Activities include swimming, canoeing, boating, water-skiing, fishing, picnicking and appreciation of flora and fauna on floodplains. On fine summer Sundays almost 16% of the population of Canberra and Queanbeyan participates in water related recreation.

Floodplains, and associated water bodies, are valuable recreational venues because they can accommodate many people, and support a wide range of recreational activities.

#### **4.5 Agriculture**

The flat land, fertile soils and proximity to water have historically made floodplains valued for agriculture. The risk of flooding has not precluded agriculture, although it has governed the type and intensity of agricultural activities. Floods confer substantial benefits to agriculture, including the deposition of silts within floodplains, the maintenance of soil fertility and the re-charging of groundwater.

#### **4.6 Urban and Industrial Development**

Urban and industrial development occurs on floodplains for a range of reasons including proximity to a water supply, water transport and recreation potential. Development on a floodplain, however, is at risk from flooding, potentially resulting in loss of life and property. In places this disadvantage has been outweighed by the advantages of undertaking development on a floodplain. One aspect of floodplain management is to balance the benefits and costs of development on floodplains.

**Table 1: The Functions and Values of Floodplains**

<b>Function</b>	<b>System Component</b>	<b>Value</b>
Flood mitigation	Additional flow capacity	The flow capacity of floodplains augments the discharge capacity of rivers. The increased flow capacity reduces the velocity of flood flows, facilitating maintenance of stable channels. These results confer social and conservation benefits.
	Capacity for temporary storage of floodwaters	The temporary storage of floodwaters attenuates peak flood discharges, reducing downstream flooding. This confers social and economic benefits downstream.
Acts as a landscape element	Landform and Vegetation	The land form of floodplains and their vegetation add diversity to the landscape, generating visual amenity.
Maintain riparian and aquatic ecosystems	Habitats include wetlands, grasslands, rivers and lakes	These habitats supports a diverse range of communities and can act as a wildlife refuge. Their maintenance confers conservation and environmental benefits.
Recreation	Aquatic and terrestrial environment	The aquatic environment is highly valued for water related recreation, particularly in inland areas.
Agriculture	Fertility of floodplains	The topography and fertility of floodplains confer economic benefits through agricultural production.
Urban and industrial development	Landform and proximity to water	Flat land close to water is valued for urban development. However, the the economic and social cost of flooding may outweigh the value of a site for development.
Infrastructure services	Land form and terrain	Floodplains are valued as areas which provide corridors for services including electricity, water supply, sewerage, roads, rail lines and bridges.
Extractive Industries	Alluvial deposits and sediment deposition	Floodplains and river channels may contain valuable deposits of sand and gravel. These deposits may be renewed by floods.

#### **4.7 Infrastructure Services**

Infrastructure is often located on floodplains to co-locate with urban development, or because of the terrain advantages floodplains offer as an avenue for services. Such services include electricity, water supply, sewerage, roads, rail and bridges.

As with urban and industrial development, infrastructure development on floodplains is at risk from flooding and may itself exacerbate the effects of flooding. The development of infrastructure on floodplains entails both benefits and costs (including potential environmental costs) which also need to be balanced in an assessment of the merits of locating infrastructure on floodplains.

#### **4.8 Extractive Industries**

River channels and floodplains frequently contain extensive deposits of sand and gravel, a valuable resource for construction and development.

Sediment deposition, erosion and transportation is a process which is in a dynamic equilibrium with river flow regimes. Sediment moved downstream under the influence of river flows may replenish eroded or extracted material.

The extraction of sand and gravel has the potential to disturb aquatic habitats and local fauna, destroy riverbank vegetation, degrade water quality and interfere with other river uses. Extraction may also upset the equilibrium between erosion and deposition, affecting the channel morphology and impacting on other river uses. Alternatively, extraction of sand from a river channel in some instance may serve to stabilise a channel or prevent material moving down a river from impacting on downstream waters. The Territory Plan expressly permits removal of sand and gravel from river corridors if required to stabilise or rehabilitate aquatic habitats.

#### **4.9 Scientific Interest**

The plants and animals associated with wetlands, and the complex nature of wetland ecosystems, impart local, national or international significance to particular wetlands.

## **5 Floodplain Objectives**

Floodplain planning and management objectives are a set of explicit outcomes required of floodplains in terms of their functions. Objectives fall into two groups; general objectives and objectives for specific floodplain functions. General objectives apply to all floodplain functions and set the planning and management priorities for their implementation. Specific objectives relate to particular floodplain functions, and provide more detail on what is required of ACT floodplains in terms of that function.

### **5.1 General Objectives**

The key objectives of these floodplain protection guidelines are to preserve the flow capacity of the floodplains of the ACT and to protect the functioning of these floodplains as ecological systems. Secondary objectives are to preserve other functions and values of floodplains where these are consistent with the key objectives. Planning and management in floodplains should be based on implementation of the key objectives while addressing specific issues related to flow capacity and water quality, landscape, conservation, recreation, services, and flood warning.

An additional general objective is that planning, development and management of floodplains is undertaken in a manner which sustains the environmental uses designated for specific river reaches in Part C2 of the *Territory Plan*.

The potential conflicts which can arise between different floodplain uses and functions are summarised in Table 2. Resolution of conflicts will be by the priorities allocated to floodplain management objectives in this document. Subsequently, planning, with its land use control measures, and management will be the tools for ensuring floodplain development and activities meet these objectives.

### **5.2 Specific Objectives**

#### **5.2.1 Flow Capacity and Water Quality**

The objective is to maintain the flow capacity of floodplains and maintain the quality of the waters of the associated rivers, streams and creeks.

#### **5.2.2 Landscape element**

The objective is to maintain and enhance the landscape character of floodplains as integral components of the National Capital Open Space System.

### **5.2.3 Maintenance of ecosystems**

The objective is to protect species and habitats, geomorphological features and aquatic conditions of the rivers, streams and floodplains so as to maintain the integrity and biological diversity of floodplain ecosystems.

### **5.2.4 Recreation**

The objective is to facilitate recreational use and enjoyment of rivers, streams and lakes in a manner which is consistent with the hydraulic functioning of floodplains and the protection of their habitats and aquatic conditions.

### **5.2.5 Infrastructure for services**

The objective is that any new or upgraded services should not increase the flood hazard within the flood zone and should not impact on areas of nature conservation within the floodplain. Most construction or upgrading of services within a floodplain must be referred to the Minister for approval under Part IV of the Land (Planning and Environment) Act 1991.

**Table 2 Potential conflicts between Floodplain functions and values**

Floodplain Function or Activity	Flow			Landscape	Ecosystems			Recreation	
	Flood storage	Flood levels	Floodplain stability	Landscape quality	Aquatic habitat	Terrestrial habitat	Movement corridor	Water based	Passive
Landscape modification	M	M	H	-	H		H	L	H
Recreation	L	L	M	M	H	H	M	-	-
Agriculture	L	L	H	H	H	M	M	L	H
Urban and Industrial Development	H	H	H	H	H	H	H	H	H
Infrastructure	M	M	M	H	M	H	M	M	M
Extractive industries	L	L	H	H	H	H	M	L	M

**Conflict Ratings**  
 L = Low  
 M = Medium  
 H = High

## 6 Floodplain Protection Guidelines

The achievement of floodplain objectives is based on the set of floodplain protection guidelines detailed below. It is recognised that a complexity of issues, spanning areas of planning and management, and involving a number of agencies with responsibility, is involved in this process. In addition, many of the floodplains in the ACT fall into the category of public land for which the Conservator of Flora and Fauna has a responsibility to produce management plans. Management plans are seen as complementary to the Floodplain Protection Guidelines in that they will serve as instruments to implement aspects of the floodplain management objectives described here, though additionally they will deal with a range of issues outside the scope of this document.

### 6.1 The Flood Standard

The selection of a flood standard for a floodplain is an important decision which defines the area of land which is subject to planning, development and management controls to prevent unwise development of land subject to flooding. Significant policies already exist in the ACT in respect of floodplain protection including:

The requirements are to ensure that all leases are protected against inundation from flood flows up to and including 100 years ARI.

*Urban Stormwater - Edition 1*

“Designers shall ensure that discharges from new urban developments, up to 100 years ARI, do not cause the capacity of downstream stormwater systems to be exceeded or result in additional scour and instability of natural creek and river systems.”

*Urban Stormwater - Edition 1*

Floodways to cater for flows up to 100 years ARI shall be provided along the alignment of existing watercourses and drainage depressions.

*Urban Stormwater - Edition 1*

“The minimum freeboard above the 100 years ARI flood shall be 300mm ...”

*Urban Stormwater - Edition 1*

Terracing may be introduced across the floodway to contain more frequent flood flows. This may enable the use of the floodplain for other purposes such as recreation where flood protection less than 100 years ARI is satisfactory.”

*Urban Stormwater - Edition 1*

“Development within the 1:100 Annual Recurrence Interval (ARI) flood zone will be restricted”

*Territory Plan: Part A2*

**The guideline** is that the flood standard be the 100 year ARI flood.

It is also predicted that global warming of the earth's atmosphere over the next 50 years will result in changes to the general circulation of the atmosphere and rainfall patterns. It is possible that these changes may lead to an increase in rainfall intensities in the ACT.

**It is recommended** that a cost/benefit analysis be undertaken to assist in the formulation of a revised flood standard when warranted by increased rainfall intensities.

## 6.2 Guideline for Floodplain Development

**The guideline** is to exclude structures other than those necessary for flood mitigation or water pollution control from the floodplain unless no alternative site is available (*Territory Plan: Part A2*).

Where structures are permitted within the flood zone they shall be designed to minimise impacts on the passage of floods or on flood levels. In the case of water storages, inundation of upstream land is accepted only on the basis of other benefits derived by the community.

## 6.3 Guideline for Siting of Structures on a Floodplain

Structures located within the floodplain will be subject to the following **guidelines**:

- Residential areas: All habitable floors are to be above 1:100 ARI flood level. Basements for car parking may be permitted below the 1:100 ARI flood level providing that permanent, internal vertical access is provided for escape in the event of flooding.
- Commercial areas: Walkways, service areas, basements are to be above the 1:100 ARI flood level.
- Institutional areas: Walkways, service areas, basement car parks are to be above the 1:100 ARI flood level.
- Archives, reference collections, etc are to be above the 1:500 ARI flood level with the establishment of emergency measures to safeguard collections in the event of a more extreme flood.

In addition, freeboard for floor levels may be required above the flood standard to mitigate the potential effects of surface waves and debris partially or totally blocking hydraulic structures.

Structures shall be capable of withstanding the forces created by flood water pressure and prevent the accumulation of flood debris in accordance with the requirements of the Building Ordinance.

Floating structures shall be securely and suitably anchored or be capable of rapid removal to a safe location in the event of an extreme flood.



## 6.4 Guidelines for Infrastructure on Floodplains

It is recommended that current essential urban infrastructure on floodplains, including electricity, water supply, and sewerage systems, roads, rail-lines, bridges and cyclepaths be maintained. New or upgraded infrastructure within the floodplain should not increase the flood hazard, adversely affect areas of nature conservation, or lead to environmental degradation within the floodplain.

**The guidelines are:**

- Peak flood levels shall not be increased above existing levels unless it can be demonstrated that the rise does not adversely affect leases or services.
- Peak flood velocities shall not be increased above existing levels unless it can be demonstrated that the increased velocity does not adversely affect the stability of the floodplain or safety. An average velocity of 2 m/s is designated as the maximum acceptable velocity over a natural floodplain.
- The duration and frequency of flood inundation shall not exceed existing flood inundation frequency and duration unless it can be demonstrated that such changes do not adversely affect the floodplain.
- Velocity-depth values shall not be increased above existing velocity-depth values unless it can be demonstrated that increased values do not adversely affect safety.
- Ponding or reduction of flows shall not be acceptable if significant sedimentation, deemed detrimental to the floodplain, would result. This shall not preclude the use of water quality control measures such as Gross Pollutant Traps, Water Quality Control Ponds or Wetlands which have been adequately designed, constructed, operated and maintained to improve water quality.

## 6.5 Guideline for maintenance of water quality on floodplains

Water of a certain quality is required to maintain the uses designated in the *Territory Plan: Part C2* for waterbodies in ACT floodplains. A number of inter-related factors affect the quality of the waters of rivers, streams and lakes in floodplains.

**The guideline** is that environmental values of waterbodies on floodplains be protected by endorsement of the *ACT Water Quality Guidelines*.

## **6.6 Guideline for protection of social and economic conditions associated with floodplains**

The social disruption and economic impact of flooding can be a significant factor in determining floodplain management plans.

**The guideline** is that analyses of social and economic impacts shall be undertaken in evaluating proposals for floodplain development.

## **6.7 Ecological and Environmental Factors**

Floodplains and their associated rivers and streams are an ecological resource which are at risk from floodplain development and modification of the flow patterns of floods. It is vital that the floodplain not be considered in isolation but as a component of the river system of which it is a part.

**The guideline** is that in respect to development and activities on floodplains, environmental values shall be protected and be based on a sound understanding of the major environmental elements contributing to the integrity of the river and its floodplain, including land use, hydrology, flora and fauna, riverine habitats and water quality.

It should be noted that development or activities on floodplains that potentially impact on water quality, social, economic, environmental or ecological issues may be referred to the Minister for approval under Part IV of the Land (Planning and Environment) Act 1991.

### Introduction

The implementation of the Floodplain Protection Guidelines will require consideration of site-specific characteristics of different floodplains. Such consideration should be significant elements of a floodplain environment, including land use, hydrology, water quality, flora and fauna, riverine habitats and landscape qualities. The major floodplains in the ACT are described below in terms of these characteristics.

### Murrumbidgee River Floodplain

The Murrumbidgee River and its floodplain are a major feature of the ACT. The topography of the floodplain ranges from gently sloping grassland in the Tharwa region to the steep rocky terrain of Red Rocks gorge.

Rural and urban activities in flatter areas and on gently sloping valleys are the most extensive catchment land uses in the local catchment. The remaining catchment is naturally vegetated country and pine forests. There are important areas for recreation, and sites of conservation value in both cultural and ecological terms, throughout the river corridor.

The river and its floodplain is the largest river habitat in the ACT, and supports a diverse aquatic habitat of high ecological value. The implementation of water quality controls on inflows from urban creeks and rivers has maintained the ecological quality of the river. The river corridor and floodplain require careful management to protect water quality, and riverine and aquatic habitats.

### Molonglo River Floodplain

The Molonglo River Floodplain comprises the reach of the Molonglo River from Oaks Estate to Lake Burley Griffin, and the reach of the Molonglo River downstream of Scrivener Dam to its confluence with the Murrumbidgee River.

In the Molonglo River upstream of Lake Burley Griffin the instream community exhibits a reduced diversity possibly due to heavy metal pollution from the former Captains Flat mine, and urban runoff from Queanbeyan. The terrain through which the river flows is generally undulating, and the river banks have become modified from a natural condition to one with extensive stands of willows. This reach is considered ecologically valuable as a major river habitat in a modified condition.

The Molonglo floodplain in the Dairy Flat region has a large flow capacity although there has been some infrastructure development in the floodplain, including construction of transmission lines across the floodplain and the extension of the Eastern Parkway across the floodplain. The backwater of Lake Burley Griffin provides a wildlife habitat adjacent to Jerrabomberra wetlands in the lower reach of the Dairy Flat floodplain. The upper reach of the Molonglo in the Dairy Flat floodplain is a venue for water-based recreation including water skiing.

The reach of the Molonglo River below Scrivener Dam flows through undulating to hilly country culminating in a series of rocky gorges and outcrops downstream. The reach from Scrivener Dam to Coppins Crossing is impacted by the modified flow and water quality regime below Scrivener Dam, and extensive riverine willows. River flows, water quality and riverbank habitats require careful management to maintain and improve habitat value. The reach also has important scenic and recreational value.

Downstream of Coppins crossing the river has retained much of its native riverbank character and has a higher ecological value. Close to the Murrumbidgee River confluence, effluent from the Lower Molonglo Water Quality Control Centre further modifies the streamflow and water quality regimes.

### **Jerrabomberra Creek Floodplain**

The Jerrabomberra Creek Floodplain comprises the floodplain of Jerrabomberra Creek, the planned Lake Jerrabomberra and the Jerrabomberra Wetlands.

The upper catchment of Jerrabomberra Creek is largely in NSW of mixed rural and urban land use. The landscape is one of open plains and gentle hills. The channel form has been affected by soil erosion and the reduction of vegetation by grazing. Water quality in the middle and lower reaches has been impacted by runoff from industrial and urban areas.

The Jerrabomberra Wetlands are located in the lower reach of the creek immediately upstream of Lake Burley Griffin. This wetland is an important conservation area in the ACT. The important wetland and associated habitats support a wide range of aquatic wildlife including over 170 species of birds some of which are protected under international treaties. The location of these wetlands has provided an opportunity to develop them as a nature education and interpretation centre. Management requirements for the wetlands are detailed in the Jerrabomberra Wetlands Management Plan.

### **Woolshed Creek Floodplain**

Woolshed Creek is a medium sized creek which discharges into the Molonglo River immediately upstream of the Dairy Flat bridge. The catchment is wholly within the ACT and is predominantly under rural land use. The landscape is one of an open floodplain and gentle hills.

The lower end of Woolshed Creek is drowned by Lake Burley Griffin and forms a deep aquatic habitat similar to the lower reaches of Jerrabomberra Creek. The lower creek is subject to flooding from major floods in the Molonglo River.

### **Ginninderra Creek Floodplain**

The Ginninderra Creek Floodplain is the floodplain associated with the lower reach of Ginninderra Creek from Ginninderra Dam wall to the ACT border. This reach of the creek contains many pools which support aquatic communities. Water quality is reduced due to urban runoff from Belconnen despite the upstream ameliorative measures.

The channel form has been retained in its original form and has been densely colonised by willows for much of its length. Recreation within this floodplain is an important use.

### **Tuggeranong Creek Floodplain**

The Tuggeranong Creek Floodplain is the floodplain associated with the lower reach of the creek from Tuggeranong Dam wall to its confluence with the Murrumbidgee River. Flow in this reach of the creek may be depleted by the presence of Lake Tuggeranong. Conversely water quality has improved due to the presence of the lakes and ponds upstream. Aquatic community diversity is limited by intermittent summer flows. The riverbank is generally steep and degraded and the creek has a low ecological value.

### **Gudgenby River Floodplain**

The Gudgenby River Floodplain is the floodplain associated with the Gudgenby River below its confluence with the Naas River. This river has high water quality, and riverbank habitats are modified to a minor extent only in the lower rural reaches. The river is an ecologically valuable habitat with a diverse aquatic community.

### **Cotter River Floodplain**

The Cotter River Floodplain is the Cotter River floodplain downstream of the Cotter Dam to its confluence with the Murrumbidgee River. The flows in this reach of the Cotter River are regulated by the Cotter Dam. The water quality is influenced by the rural and plantation forestry land use, and by impoundment. Recreational use in the Cotter River has partially modified and disturbed river-bank habitats. This reach of the Cotter River retains a high ecological value.

### **Paddys River Floodplain**

The headwaters of Paddys River are in the forested zone of Namadgi National Park and Tidbinbilla Nature reserve. The middle reaches pass through grazing land, and the lower reaches pass through natural forest and pine plantations. The river is an ecologically valuable stream habitat which is subject to the impact of rural and forestry activities in the catchment.

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## GLOSSARY

<b>AEP</b>	the Annual Exceedance Probability describes the likelihood of a flood of a given or greater size occurring once in any one year.
<b>ARI</b>	the Average Recurrence Interval describes the average interval between floods of a given or greater size recurring.
<b>catchment</b>	the area of terrain draining to a site. It always relates to a particular location and may include the catchments of tributary streams as well as the main stream.
<b>designated flood</b>	see flood standard
<b>development</b>	the modification or change of a land-use; the erection of a building or the carrying out of work.
<b>discharge</b>	the rate of flow of water in terms of volume per unit time.
<b>ecology</b>	a branch of biology which studies the interaction of organisms between one another and with their surroundings.
<b>ecosystem</b>	a system of interacting organisms in a particular habitat.
<b>environment</b>	the physical, chemical and biological surroundings in which plants, animals and ourselves live.
<b>erosion</b>	process of wearing away of land surfaces by natural forces, eg. wind, water.
<b>eutrophication</b>	the enrichment of lakes and rivers with nutrients, thereby increasing the quantity of algae or aquatic plants.
<b>flood</b>	increased river or stream flow due to the runoff of water from a catchment after rainfall.
<b>flood awareness</b>	an appreciation of the likely effects of flooding and a knowledge of the meaning of flood warnings.
<b>flooding</b>	flooding results when the channel of a river or creek or a water body cannot contain the runoff from its catchment



The ACT Emergency Service uses the following definition in flood warnings:

<b>minor flooding:</b>	causes inconvenience such as the closure of minor roads and the inundation of low level bridges.
<b>moderate flooding:</b>	causes inundation of low-lying areas, requiring the removal of stock or evacuation of some houses. Main traffic bridges may be inundated.
<b>major flooding:</b>	causes flooding of extensive rural areas and the isolation of properties. Villages, towns and/or appreciable urban areas are flooded.
<b>local flooding:</b>	is where intense rainfall could be expected to cause high runoff in restricted areas yet not cause significant rises in main streams.
<b>flood hazard</b>	potential for damage to property or persons due to flooding.
<b>flood liable land</b>	land which may be subject to flooding.
<b>floodplain</b>	the portion of a river valley adjacent to the river channel which 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.
<b>flood proofing</b>	a combination of measures in the design and/or construction of individual buildings or structures subject to flooding for the reduction or prevention of flood damage.
<b>flood standard</b>	the flood selected for planning services which is used to define the flood zone. The adopted flood standard is the 1:100 ARI flood.
<b>flood storages</b>	the areas of the floodplain that are important for the temporary storage of floodwaters which are later discharged as the flood recedes.
<b>flood zone</b>	the area of land affected by flooding during a designated flood.
<b>freeboard</b>	a height above the level of a designated flood to allow for factors such as wave action and localised flow effects.
<b>geomorphology</b>	the study of the physical and chemical processes which shape the earth's surface and their relation to its geological structures and climate.
<b>hydraulics</b>	the study of the flow of water.

<b>hydrology</b>	the study of the process of the conversion of rainfall into runoff particularly in the generation of floods.
<b>inundation</b>	the covering of land by floodwaters.
<b>probable maximum flood</b>	the flood which is calculated to result from the probable maximum precipitation
<b>probable maximum precipitation</b>	the rainfall estimated to be the maximum which is ever likely to occur
<b>probability</b>	a statistical measure of the expected frequency or occurrence of an event
<b>runoff</b>	the amount of rainfall which is not intercepted or absorbed into the ground during a storm and which subsequently runs off from the ground surface. It is also known as rainfall excess.
<b>sedimentation</b>	process or rate of deposition of sediment.
<b>turbidity</b>	the cloudiness of water as a result of water colouration or sediment suspended in the water column.
<b>urban infrastructure</b>	structures that provide services to support habitation; includes roads, bridges, electricity supply, water supply and sewerage works.