

QUEANBEYAN RIVER RIPARIAN CORRIDOR STRATEGY

Incorporating the Platypus Awareness and Conservation Strategy

Prepared for
Queanbeyan City Council



Australian Government



Australian Platypus Conservancy



DOCUMENT TRACKING

ITEM	DETAIL
Project Name	Queanbeyan River Corridor Plan of Management and Platypus Awareness and Conservation Strategy
Project Number	11SUTPLA-0001
File location	G:\Synergy\Projects\11SUTPLA\11SUTPLA-0001 Queanbeyan River Corridor Plan of Management\Report
Prepared by	Kathryn Korbel, Jo Daly and Ian Dixon – Eco Logical Australia Geoff Williams and Melody Serena – Australian Platypus Conservancy
Approved by	Beth Medway – Eco Logical Australia
Status	Final
Version Number	4
Last saved on	24 February 2012
Cover photos	From top left: Platypus; early morning walk over tributary crossing; flooding Dec 2010; Queanbeyan regatta

This report should be cited as 'Eco Logical Australia 2012. *Queanbeyan River Corridor Plan of Management incorporating the Platypus Awareness and Conservation Strategy*. Prepared for Queanbeyan City Council.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from the Australian Platypus Conservancy, ACT Waterwatch and Queanbeyan City Council.

Funding for this project has been provided through the Australian Government's 'Water for the Future' initiative and the 'Strengthening Basin Communities' program.

Disclaimer

This document may only be used for the purpose for which it was commissioned and in accordance with the contract between Eco Logical Australia Pty Ltd and Queanbeyan City Council. The scope of services was defined in consultation with Queanbeyan City Council, by time and budgetary constraints imposed by the client, and the availability of reports and other data on the subject area. Changes to available information, legislation and schedules are made on an ongoing basis and readers should obtain up to date information.

Eco Logical Australia Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report and its supporting material by any third party. Information provided is not intended to be a substitute for site specific assessment or legal advice in relation to any matter. Unauthorised use of this report in any form is prohibited.

Contents

Executive Summary	vi
1 Introduction.....	1
1.1 Background.....	1
1.2 Need for a new plan	1
1.3 Study area	2
1.4 Study process and consultation.....	5
2 Legislative and planning framework	7
2.1 Commonwealth legislation.....	7
2.2 NSW legislation	7
2.3 Local plans and policies	11
2.4 Other plans and policies	13
3 History and features of the corridor	15
3.1 Climate.....	15
3.2 Geology and soils	15
3.3 Heritage	17
3.3.1 Indigenous history	17
3.3.2 Early settlement.....	17
3.4 Water management	18
3.4.1 Weirs and dams.....	18
3.4.2 Water licences	20
3.4.3 Stormwater and sewer.....	20
3.4.4 Flooding and drought.....	21
3.4.5 Water quality.....	22
3.5 Ecology	22
3.5.1 Vegetation communities	23
3.5.2 Iconic fauna	26
3.5.3 Threatened species	26
3.5.4 Key threatening processes	27
3.5.5 Recovery planning.....	28
3.5.6 Recent recovery effort	28
3.6 Bushfires.....	31
3.7 Recreation and access	31
3.8 Caravan park	35

3.8.1	Current status and management.....	35
3.8.2	Lessee's strategy.....	36
3.8.3	Future use of the site	37
3.9	Future development.....	37
3.10	Community engagement	37
3.11	Summary of management issues and opportunities	38
4	Strategic framework	39
4.1	Vision	39
4.2	Objectives	39
4.2.1	Land management objectives.....	39
4.2.2	Aquatic objectives.....	42
4.3	Priorities.....	42
4.4	Actions, costs and performance measures	42
5	Implementation	56
5.1	Funding and resources.....	58
5.2	Leases and licensing	59
5.3	Approvals.....	60
5.4	Monitoring and adaptive management	61
	References	62
	Appendix A: Land within Queanbeyan River Corridor	65
	Appendix B: Platypus Awareness and Conservation Strategy	68
	Appendix C: Community brochure.....	153
	Appendix D: A0 Community Consultation poster.....	156
	Appendix E: Community notice.....	157
	Appendix F: Initial feedback.....	158
	Appendix G: Public exhibition	167
	Appendix H: Threatened flora and fauna.....	173
	Appendix I: Weeds	178
	Appendix J: Species suitable for revegetation	186
	Appendix K: Relevant actions from the CBD Master Plan (Place 2009).....	188

List of Figures

Figure 1: The study area	1
Figure 2: Land ownership and zoning – lower section	2
Figure 3: Land ownership and zoning – middle section	3
Figure 4: Land ownership and zoning – upper section	4
Figure 5: Flooding and stormwater.....	19
Figure 6: Vegetation communities (BES 2008) and threatened species (approximate locations).....	24
Figure 7: Recreation facilities	34
Figure 8: Key actions.....	55

List of Tables

Table 1: Land use zones applicable to the river corridor	12
Table 2: Significant listed heritage items.....	18
Table 3: Threatened species recorded in the study area.....	26
Table 4: Results of fish monitoring 2004-2011	31
Table 5: Recreation and access.....	32
Table 6: Community participation and education	37
Table 7: Categories and objectives for community land under the LG Act.....	39
Table 8: Objectives for private land, operational land and non-reserve Crown land	41
Table 9: Pollution control actions	45
Table 10: Access and recreation actions	46
Table 11: Rehabilitation actions (weed and erosion control, regeneration, revegetation)	49
Table 12: Flood management actions	51
Table 13: Planning and development actions	51
Table 14: Actions relevant to coordination of works.....	52

Table 15: Education actions for community, Council staff, developers etc.....	53
Table 16: Research and monitoring actions.....	54
Table 17: Implementation guide	56
Table 18: Principles for licensing and leasing community land.....	59

Abbreviations

ABBREVIATION	DESCRIPTION
ACWA	Actions for Clean Water (a collaborative project by natural resource management organisations in the Upper Murrumbidgee River catchment)
CBD	Central business district
CL Act	<i>Crown Lands Act 1989</i>
EEC	Endangered ecological community
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cwth)</i>
DPI	Department of Primary Industries
GPT	Gross pollutant trap
LEP	Local Environmental Plan
LGA	Local Government Area
LG Act	<i>Local Government Act 1993</i>
NTG	Natural temperate grassland
OEH	Office of Environment and Heritage
PACS	Platypus Awareness and Conservation Strategy
SEPP	State Environment Planning Policy
TSC Act	<i>Threatened Species Conservation Act 1995</i>
WSP	Water sharing plan

Executive Summary

A Plan of Management for the Queanbeyan River corridor was prepared by Connell Wagner in 1999 on behalf of Queanbeyan City Council. The plan made recommendations to improve the environmental quality and amenity of the river corridor. Some of the actions that have been implemented include removal of willows and aquatic weeds, revegetation and construction of recreational paths.

Council identified the need for a new plan to fulfil obligations under the NSW *Local Government Act 1993* (LG Act) and help prepare for a future with less water under predicted climate change. This plan, which includes a *Platypus Awareness and Conservation Strategy*, has been prepared by Eco Logical Australia Pty Ltd and the Australian Platypus Conservancy. Funding for the plan was provided through the Australian Government's 'Water for the Future' initiative and the 'Strengthening Basin Communities' program.

This plan provides a vision for the river corridor to be achieved by 2030, supported by actions to be implemented over the next ten years. It has been developed in close consultation with the community and government agencies. Many of the actions are consistent with those presented in the 1999 plan.

This strategy provides an integrated approach to management of the riparian corridor, covering Council-owned land, Crown land and private land. Council will be primarily responsible for implementation of the plan, and Council-owned land has been categorised in accordance with the LG Act to facilitate this process. Other landowners/managers are encouraged to apply the principles and objectives detailed in the plan to guide their own management practices along the river.

The strategy aims to improve environmental quality, amenity and recreational opportunities by reducing threats, and rehabilitating the river corridor and its tributaries. High priority actions recommended in the strategy can be summarised as follows:

- Increase riparian habitat and amenity of the river and its tributaries through pollution reduction, erosion control, stormwater treatment, rubbish removal, weed removal, regeneration and revegetation
- Improve public access along the corridor by a network of sealed paths and unsealed tracks suitable for walkers and cyclists, allowing for circuits of variable length and condition
- Strict planning and development controls to ensure future development does not adversely affect the river corridor
- Improved coordination of rehabilitation activities within the corridor by government agencies and the community (led by Council)
- Increased community education and involvement

The strategy provides a strong foundation for Council to seek grant funds and other sources of funding to provide a coordinated and prioritised approach to managing the Queanbeyan River corridor. Community involvement, collaboration with adjacent landowners/managers and cooperation with government agencies will strengthen the effectiveness of the plan.

1 Introduction

1.1 BACKGROUND

The Queanbeyan River in southern NSW originates some 70 km east—southeast of Queanbeyan. The river flows from Googong Dam near the edge of the Queanbeyan local government area, northward through the central business district and suburbs of the City of Queanbeyan. It has its confluence with the Molonglo River at Oaks Estate near the NSW-ACT border, eventually becoming the Murrumbidgee then Murray River.

The Queanbeyan River is recognised by the residents and visitors to Queanbeyan as a valuable natural asset. It is important for water supply, amenity and recreation. Sections of the river are degraded, which is typical of rivers located in urban areas. Despite this, the river corridor provides important habitat for native species such as the platypus, water rat and wombat. The health of the river also plays a vital role for communities and ecosystems further downstream.

Past activities such as rural and residential development, and construction of the weirs and Googong Dam, have caused the Queanbeyan River corridor to deteriorate. Native vegetation was cleared in many sections along the river. This was associated with erosion, sedimentation, weed infestation, loss of habitat, poor water quality and loss of amenity.

Many long term residents of the area remember the river having clear water, suitable for boating and swimming. In recent years the river corridor has been subject to a range of management measures to improve conditions. These measures were identified in plans such as the:

- *Queanbeyan River Corridor Study* (NECS 1997)
- *Queanbeyan River Corridor Plan of Management* (Connell Wagner 1999)
- *Urban Salinity Management Plan* (Murrumbidgee CMA undated)
- *Queanbeyan CBD Master Plan* (Place Design Group with Leyshon Consulting, ARUP and Elton Consulting 2009)
- *Management of Aquatic Plants on the Queanbeyan River Weir Pool* (Queanbeyan City Council 2003)
- Concept design drawings for the Queanbeyan Golf Course (dsb Landscape Architects 2004)

Key measures identified in these plans that have been implemented to varying degrees include:

- Willow removal
- Aquatic weed removal
- Construction of recreational paths along river
- Revegetation
- Installation of water quality control devices e.g. gross pollutant traps
- Erosion controls
- Installation of signage

1.2 NEED FOR A NEW PLAN

Queanbeyan City Council identified the need for a new plan to fulfil obligations under the NSW *Local Government Act 1993* and help prepare for a future with less water under predicted climate change.

This new plan provides a vision for the river corridor to be achieved by 2030, supported by actions to be implemented over the next ten years.

This strategy has been developed in accordance with the following scope:

- Undertake extensive community consultation to draw out community concerns and expectations for the Queanbeyan River over the next 20 years.
- Review existing documentation and undertake additional research required to prepare a new Queanbeyan River Riparian Corridor Strategy.
- Ensure the strategy meets legislative requirements such as Section 36 'Preparation of draft plans of management for community land', of the *Local Government Act 1993*.
- Ensure the strategy identifies actions that promote, encourage and provide for the use of the land; provide facilities on the land; and meet the current and future needs of the local community and of the wider public.
- Ensure the strategy facilitates the long term protection and enhancement of the river. It will form the basis for future Council and government agency policy for the long term management and maintenance of the river corridor.
- Ensure that objectives are in alignment with the overarching regional plans such as the *Molonglo Catchment Strategy* and the *Murrumbidgee Catchment Action Plan*.

While Council acknowledges that this plan is not able to specifically control areas of private land, private landholders are encouraged to apply the principles and objectives detailed in this plan to guide their own management practices along the river. There are many cases where it is mutually beneficial for all landholders to work together to rehabilitate the river corridor.

1.3 STUDY AREA

The section of the Queanbeyan River corridor that defines the *study area* or *riparian corridor* is within the Queanbeyan local government area (LGA) and is at least 40 m either side of the river¹. Where parcels of land extend beyond the 40 m buffer, this Plan gives consideration to the whole parcel as part of the corridor.

For management planning purposes the corridor has been divided into three units based on its characteristics (shown in **Figure 1**; refer to **Section 3** for further details). These units include:

- The upper corridor – the LGA boundary just below Googong Dam to the urban edge end of Barracks Flat Place
- The middle corridor – the urban edge end of Barracks Flat Place to the city weir
- The lower corridor – the city weir to the railway bridge (i.e. ACT/Queanbeyan LGA boundary)

Land zoning and ownership characteristics within the upper, middle and lower sections of the corridor are depicted in **Figures 2 to 4**. Land parcels which are the subject of this plan are further identified in **Appendix A**. Additional information about zoning is given in **Section 2.3**.

¹ This minimum width of the river corridor has been determined in accordance with the definition of a core riparian zone under the NSW *Water Management Act 1993*.

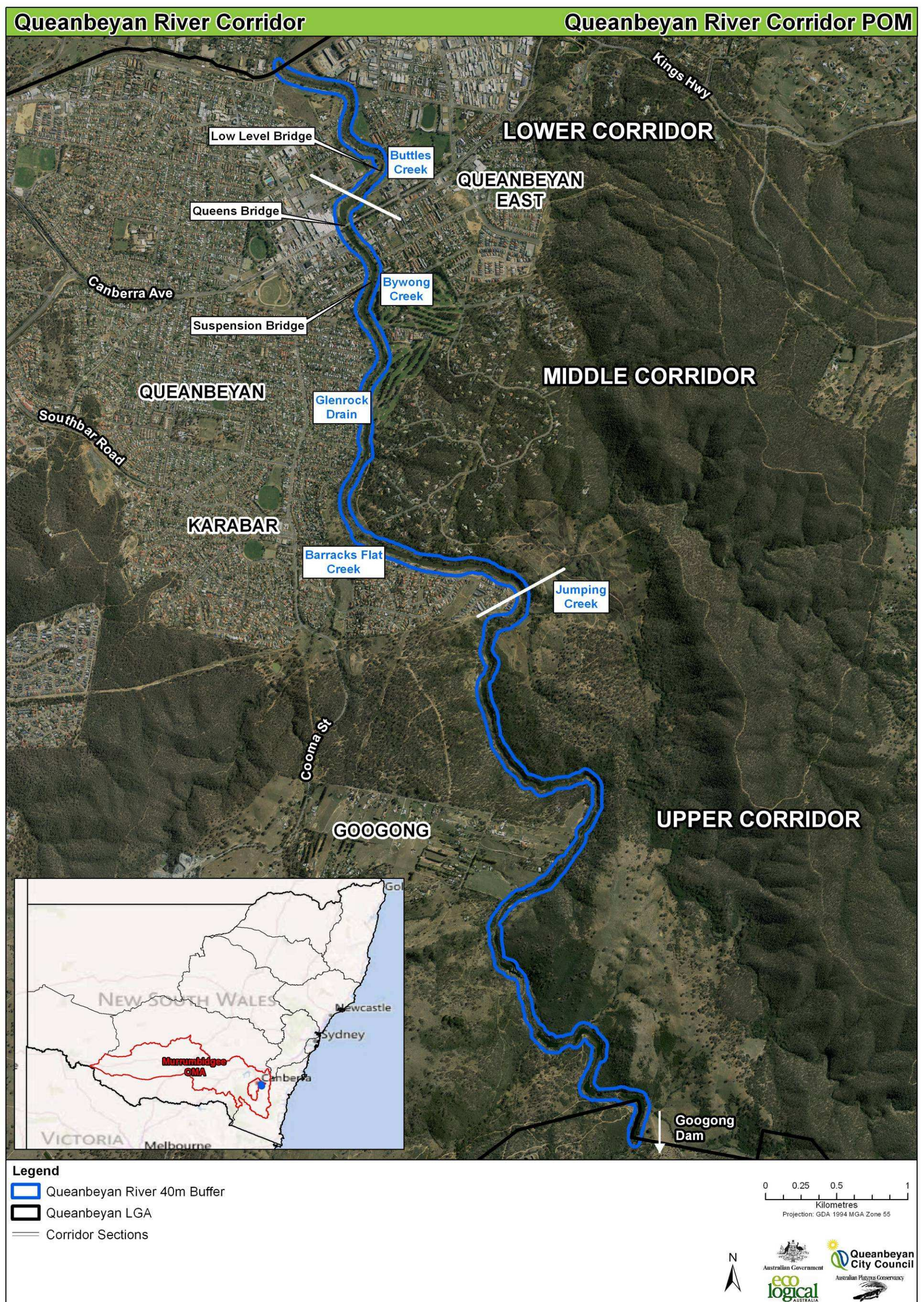


Figure 1: The study area



Figure 2: Land ownership and zoning – lower section

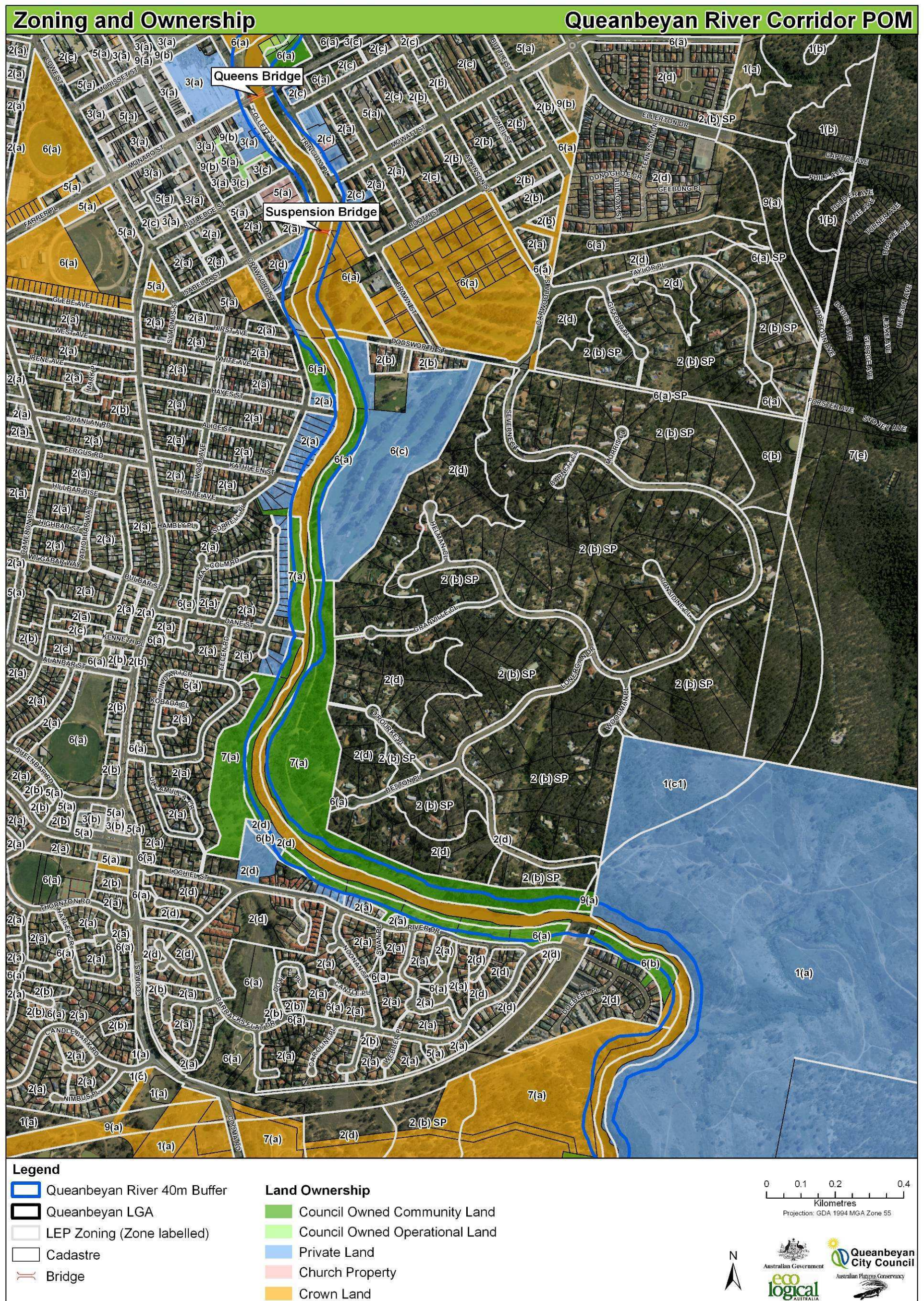


Figure 3: Land ownership and zoning – middle section

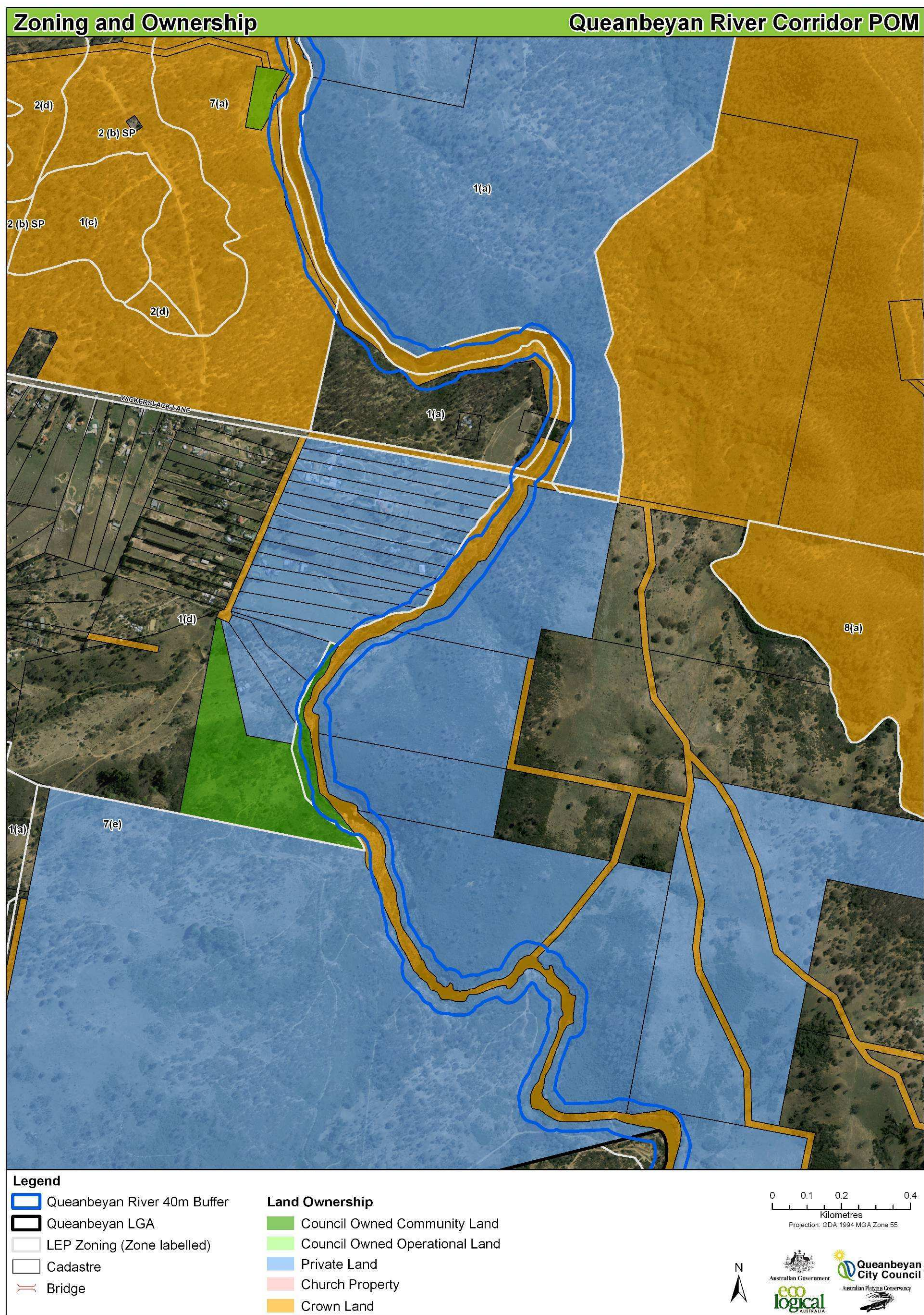


Figure 4: Land ownership and zoning – upper section

This Strategy also broadly considers impacts caused by activities beyond the immediate study area (e.g. possible future development, weed and sediment sources, and regulated flows from Googong Dam). Consideration has been given to sub-catchments associated with the Queanbeyan River including Jumping Creek, Barracks Flat Creek, Glenrock Drain, Bywong Creek and Buttles Creek (see **Figure 1**). However, these areas have not been investigated in detail.

1.4 STUDY PROCESS AND CONSULTATION

This strategy has been prepared by Eco Logical Australia Pty Ltd and the Australian Platypus Conservancy on behalf of Queanbeyan City Council. Funding for the plan was provided through the Australian Government's 'Water for the Future' initiative and the 'Strengthening Basin Communities' program. The *Platypus Awareness and Conservation Strategy* report, which is an important part of this plan, is provided in **Appendix B**.

This plan has been prepared in close consultation with Council, other agencies and the community. The study process summarised below highlights opportunities for community consultation.



Initial notification

The community was initially informed about the project via a leaflet (**Appendix C**) delivered to 500 households and other known stakeholders, a poster on display in the library and Council's office (**Appendix D**), and through a range of media:

- Media release (**Appendix E**)
- Council's City Life newsletter
- Council's regular notice in the local newspaper
- Council's website
- Social media (e.g. Twitter, Facebook)
- ACT Waterwatch's website

All forms of initial notification included an email address, direct phone line to the consultant and postal address so that people could register an interest and/or provide comments.

Initial consultation

Face-to-face consultation was conducted in early June 2011 to encourage people to provide their ideas about how to improve the river corridor.

- A display in Riverside Plaza Shopping Centre from 5 pm to 9 pm on Thursday 2 June was staffed by the consultant and Council's project manager. There was a steady stream of attendees, including people who had specifically come to look at the display and talk to the project team, and others who were shopping then took the opportunity to find out about the project and provide comments.
- Display at the library from 10 am to noon on Saturday 4 June
- Walk along the river near the CBD (met at The Q steps) from 1 pm on Saturday 4 June

- Walk near River Drive Reserve at 7 am on Sunday 5 June
- Display at Council's Enviro Expo from 10 am to 4 pm at the Queanbeyan Conference Centre. The Platypus Conservancy gave a presentation at 10.30 am
- Incidental consultation also occurred during fieldwork

Results of the initial consultation sessions are given in **Appendix F**.

Public exhibition

The draft *Queanbeyan River Corridor Plan of Management incorporating the Platypus Awareness and Conservation Strategy* was placed on public exhibition following approval by Queanbeyan City Council on 26 October 2011.

Letters were sent to 360 households and 50 stakeholders to invite them to a community meeting and notify them of the public exhibition period. Copies of the letter templates are provided in **Appendix G**. Broader notification of the exhibition period and meeting was given in the local papers (Queanbeyan Age and Chronicle) and on Council's website.

A community meeting was held on Thursday 17th November 2011 at 6 pm in the Harry Hesse Room (262 Crawford Street Queanbeyan). The meeting was attended by about twenty people. ELA and APC consultants presented the key points from the plan and, with Council officers, responded to questions and comments. Maps and action tables were on display and attendees were invited to suggest changes and make comments.

The draft plan was on exhibition for 45 days, from 28 October until 12 December 2011. The report was made available to the community via Council's website and at Council's office. Selected stakeholders were provided with a copy. Copies were also available at the community meeting.

Written submissions were invited until 12 December 2011, although a number of submissions were made later and considered in the final revisions to the plan. The main issues identified in submissions and at the meeting are listed in **Appendix G**.

2 Legislative and planning framework

2.1 COMMONWEALTH LEGISLATION

Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)

The EPBC Act provides a national scheme for environmental protection and biodiversity conservation. It incorporates referral mechanisms and environmental impact assessment processes for projects that could impact matters of national significance. Triggers for referral to the Commonwealth include endangered ecological communities (EECs), threatened species and JAMBA/CAMBA species.

There are four species that have been recorded in the riparian corridor of the Queanbeyan River that are listed under the EPBC Act:

- Murray Cod (*Maccullochella peelii peelii*) is listed as threatened
- Pink-tailed Worm Lizard (*Aprasia parapulchella*) is listed as vulnerable
- Riverine Pomaderris (*Pomaderris pallid*) is listed as vulnerable
- Thick-lipped Spider Orchid (*Caladenia tessellata*) is listed as vulnerable

Areas of Natural Temperate Grassland and Box-Gum Woodland (EECs listed under the EPBC Act) are found within the corridor.

2.2 NSW LEGISLATION

Crown Lands Act 1989

As shown in **Figures 2 to 4**, parts of the riparian corridor are Crown land. These areas include:

- Crown reserves, such as Blundell Park. The *Crown Lands Act* provides for preparing plans of management for Crown Reserves in consultation with the community
- Tenured land (i.e. land that is directly leased, licensed or allowed to be used for a range of public, private and community uses). Examples include Riverside Caravan Park and part of Queanbeyan Golf Course
- Other Crown land such as the riparian corridor between Barracks Flat Place and Wickerslack Lane
- Submerged land such as the Queanbeyan riverbed is classified as a type of Crown land

Crown lands are administered by the NSW Government in accordance with the *Crown Lands Act*. The Council has been appointed by the Minister for Lands to have care, control and management of a number of Crown reserve areas as the 'Queanbeyan City Council Crown Reserves Reserve Trust'. This Crown land area includes parts of the Queanbeyan river foreshore.

Crown lands may be subject to claim by the Aboriginal community. If the claim is successful, the land title becomes freehold rather than Crown. There are instances where this has previously occurred in the Queanbeyan River corridor. There are some Crown lands within the corridor that are currently subject to Aboriginal land claim.

Aboriginal Land Rights Act 1983

The purpose of this Act are to provide land rights for Aboriginal persons, represent Aboriginal Land Councils in New South Wales who have a vested interest in land. It also helps to provide for the acquisition of land and the management of land and other assets and investments, the allocation of funds to provide for the provision of community benefit schemes by or on behalf of those Councils.

Through the *NSW Aboriginal Land Rights Act 1983*, vacant Crown land not required for an essential purpose or for residential land, is returned to Aboriginal people.

Aboriginal land rights aim to redress past injustices when Aboriginal people were dispossessed of their land by colonisation. This dispossession led to many social, economic and physical problems for Aboriginal people.

Crown Lands investigates and assesses Aboriginal land Claims across the State. There are currently several parcels of land along the Queanbeyan River corridor subject to land claim.

Native Title Act 1994

The objectives of this Act are to validate any past acts, and intermediate period acts, invalidated because of the existence of native title and to confirm certain rights and to ensure that New South Wales law is consistent with standards set by the Commonwealth Native Title Act for future dealings affecting native title.

Native Title is the name Australian law gives to the traditional ownership of land and water that have always belonged to Aboriginal people according to their traditions, laws and customs. These rights are different to and separate from the statutory right of Aboriginal Land Councils to make claims for land under the *NSW Aboriginal Land Rights Act 1983*. Native title is the legal recognition of Indigenous Australians rights and interests in land and waters according to their own traditional laws and customs. Unlike land rights, native title is not a grant or a right that is created by governments.

Local Government Act 1993

Council owned land must be classified as either community land or operational land under the *Local Government Act 1993* (LG Act). Community and operational lands in the river corridor are identified in **Figures 2 to 4**.

Operational land has no special management restrictions other than those that may apply to any piece of land such as zoning. Operational land does not require a plan of management.

Parcels of land that are designated as Council-owned community land must be managed in accordance with a Plan of Management prepared under the LG Act.

Conditions that apply to community land are:

- It cannot be sold
- It can only be leased, licensed or have any other estate granted over the land under specific conditions
- It must be categorised according to the following:
 - Park
 - Sportsground
 - General community use
 - Area of cultural significance
 - Natural area (bushland, wetland, watercourse, foreshore or escarpment)

- A plan of management must be prepared or applied in consultation with the community. The plan should identify:
 - The category of land
 - The objectives and performance targets for the land
 - The means by which the Council proposes to achieve the plan's objectives and performance targets (i.e. the actions)
 - The manner in which the Council proposes to assess its performance with respect to the plan's objectives and performance targets

The way community land is to be used and managed is strictly governed by an adopted plan of management. Council can amend plans of management at any time by adopting a new plan. However, any significant amendment is regarded as another plan of management. The amended plan must be put on public exhibition with opportunities for submissions prior to adoption.

Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) forms the basis of town planning in New South Wales. The EP&A Act provides the legislative power for the preparation of State Environmental Planning Policies (SEPPs) and Local Environmental Plans (LEPs.) This includes the *Queanbeyan Local Environmental Plan 1998* (LEP 1998) – see **Section 2.3**.

SEPP 44 - Koala habitat protection

Koalas have been sighted within the outskirts of Queanbeyan city near the riparian zone (ELA 2008). SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. However, Queanbeyan LGA is not listed in Schedule 1 of the SEPP, so this policy does not apply.

Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* requires that Councils consider the impact on threatened species in fulfilling their statutory responsibilities under the EP&A Act. It also provides for the preparation of Species Recovery Plans that may bind Council to certain actions or activities on Council owned land.

There are two flora species, six fauna species and three endangered ecological communities listed under the TSC Act that have been recorded within the riparian corridor, with a further seven species of fauna that have not been recorded but are likely to forage within the corridor because of the availability of suitable habitat. Threatened species and ecological communities occurring and likely to occur within the Queanbeyan River riparian corridor are listed in **Section 3.5**.

National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) is the principal legislation governing the protection and management of Aboriginal heritage in NSW. An Aboriginal object is considered to be known if:

- It is registered on the AHIMS database
- It is known to the Aboriginal community
- It is located during an investigation of the area conducted for a development application

An AHIMS search was conducted on 8 August 2011 (GDA zone 55; Eastings 702751-705353; Northings 6079089 – 6086881; buffer 0 m). The search found 85 Aboriginal sites have been recorded

in or near the above location. These results partly reflect survey effort and there are likely to be other sites found in areas that have not yet been surveyed.

The Act makes it an offence to damage, deface, destroy, disturb or collect any Aboriginal object or evidence without the approval of the Office of Environment and Heritage (OEH). Recent amendments to the Aboriginal heritage provisions of the Act differentiate between type and severity of these 'harm' offences and provide a number of defences to prosecution. The most serious offence, and carrying the higher penalties, is the offence of knowingly harming or desecrating an Aboriginal object.

The Act provides a 'due diligence' defence for unintentional harm to Aboriginal objects where an activity is undertaken in compliance with an adopted (OEH endorsed) industry code of practice, in compliance with an Aboriginal Heritage Impact Permit, or after following the process set out in the OEH code of practice for due diligence. There is no requirement to follow the due diligence process for certain activities defined as low impact – such as specified land management, maintenance, surveying or environmental rehabilitation works.

In a local government context, these low impact activities (as defined in the accompanying Regulation) include maintenance of existing roads or fire trails or tracks, maintenance of existing utilities, and environmental rehabilitation works (such as temporary silt fencing, tree planting, bush regeneration and weed removal). Certain activities are also exempt from the Aboriginal heritage offences, while other actions are described as 'trivial or negligible' events and no longer considered as 'harm'.

Noxious Weeds Act 1993

The *Noxious Weeds Act* identifies noxious weeds, control measures, public and private responsibilities, and provides a framework for the management of noxious weeds across NSW. Various noxious weeds have been recorded within the study area (**Appendix H** lists all noxious weeds within the LGA). In recent years, Council has implemented a willow removal program across the Queanbeyan River corridor. Other recent efforts to control noxious weeds include Landcare activities (e.g. at Buttles Creek and White Rocks).

Fisheries Management Act 1994

The *Fisheries Management Act 1994* is administered by the Department of Primary Industries (DPI) and applies to aquatic habitat and ecology, including all freshwater vertebrate and invertebrate taxa and their associated habitat. The Act has provisions to declare and list threatened species of fish, endangered populations and ecological communities, and key threatening processes. Refer to **Section 3.5** for further information.

Infrastructure State Environmental Planning Policies (SEPP) 2007

The Infrastructure SEPP includes generic provisions to allow for development to be exempt or require a Part V Assessment. There are 23 classes of infrastructure development where a development application is not required and only a Part V Assessment has to be undertaken. Some of the relevant classes of infrastructure development that may be carried out by or on behalf of Council on a public reserve are:

- Information facilities such as information boards
- Lighting
- Landscaping
- Amenity facilities
- Environmental management works (e.g. bush regeneration)

Heritage Act 1977

The *Heritage Act* sets out responsibilities for assessing and managing non-Aboriginal heritage. It aims to encourage appreciation and conservation of the State's heritage. Heritage values in the corridor are discussed in **Section 3.3**.

Native Vegetation Act 2003

The *Native Vegetation Act* (NV Act) aims to protect the health of land, rivers and wildlife by preventing broadscale clearing of native vegetation. In the Queanbeyan LGA, the NV Act is administered by the Murrumbidgee Catchment Management Authority.

Rural Fires Act 1997

The NSW Rural Fire Service has developed several policy documents and guidelines relating to fire management, including the *Bush Fire Environmental Assessment Code* (RFS 2003) and *Planning for Bushfire Protection* (RFS and Planning NSW 2001). The former identifies threatened species, threatened populations and endangered ecological communities to be considered when undertaking hazard reduction burns, and specifies conditions relating to the use of fire and mechanical forms of hazard reduction for each species, population or community. The planning document outlines planning matters to be taken into account for developments in bushfire prone areas.

Bushfire management issues in the Queanbeyan corridor are discussed in **Section 3.6**.

Water Management Act 1993

The *Water Management Act 2000* aims for sustainable and integrated management of the State's water for the benefit of both present and future generations. The Act recognises the need to allocate and provide water for the environmental health of our rivers and groundwater systems, while also providing licence holders with more secure access to water and greater opportunities to trade water in particular through the separation of water licences from land. Issues relevant to water management within the Queanbeyan corridor are discussed in **Section 3.4**.

2.3 LOCAL PLANS AND POLICIES

Local Environmental Plan

Local Environmental Plans (LEPs) outline the land use zones within the LGA, the types of development permitted within each zone and special provisions that relate to heritage, flooding, noise, bushfire, scenic protection, contamination, pollution, main roads etc. As depicted in **Figures 2 to 4**, the corridor is affected by a variety of land use zones under the *Queanbeyan LEP 1998* and *Yarrowlumla LEP 2002*. These are tabulated below.

The table below also indicates the equivalent zone that would be applied under the NSW Standard Instrument. Queanbeyan Council has drafted a comprehensive LEP in line with the Standard Instrument. The comprehensive LEP is currently being reviewed by the Planning Minister and will be publicly exhibited prior to finalisation.

Table 1: Land use zones applicable to the river corridor

CODE*	LEP LAND USE ZONES	STANDARD INSTRUMENT ZONE**
1(a)	Rural A	RU1 – Primary Production RU2 – Rural Landscape
1(d)	Rural Residential	R5 – Large Lot Residential
2(a)	Residential A	R2 – Low Density Residential
2(b)	Residential B	R3 – Medium Density Residential
2(c)	Residential C	R4 – High Density Residential
2(d)	Residential D	R1 – General Residential
3(a)	General Business	B2 – Local Centre B3 – Commercial Core
3(c)	Business Park	B7 – Business Park
5(a)	Special Uses 'A'	SP1 – Special Activities SP2 – Infrastructure
6(a)	Recreation	RE1 – Public Recreation
6(c)	Open Space 'C' – Private Recreation	RE2 – Private Recreation
7(a)	Environmental Protection A	E2 – Environmental Conservation E3 – Environmental Management
7(e)	Environmental Protection	E2 – Environmental Conservation E3 – Environmental Management
9(a)	Road A	

*Refer to **Figures 2 to 4**

**Equivalent zones

Council is currently reviewing applications to rezone areas at Googong and Jumping Creek from rural to residential. If approved, these would result in significant areas of urban development in the mid to upper catchment. Infrastructure that would be needed to support these developments includes a sewage treatment plant and stormwater treatment systems.

Council's policies and plans

Council's policies that are relevant to management of the river corridor are listed below.

- *Noxious weeds policy* (2010) aims to effectively manage the control of noxious weeds
- *Stormwater disposal – rural residential land policy* (2009) aims to establish standards for stormwater disposal on rural residential land and limit uncontrolled stormwater overland flow on these lands
- *Water restriction policy* (2009) aims to meet Council's obligations under the contract for potable water supply from ACTEW in relation to water restrictions. Under this policy, when Council is advised by ACTEW that the available stored water in the water supply system, or the available capacity of supply from that system, is insufficient to allow the unrestricted consumption of water for purposes other than domestic purposes, Council will restrict:
 - The purpose of which the water can be used, or
 - The times when the water can be used, or
 - The methods by which the water can be used, or
 - The quantities of the water that can be used

- *Street verge / nature strip policy* (draft 2011) aims to:
 - To reduce silt build up in Council's stormwater network
 - Improve pedestrian safety through verge treatments
 - Reduce silt load into the environment
 - Set out the guidelines in relation to the development
 - Maintenance of verges on Council owned road reserves

Council's (2010) *Natural Areas Plan of Management* categorises three types of Natural Areas within community land in the LGA:

- Urban Bush Reserves (Bushland)
- Escarpment
- Queanbeyan River Corridor (Watercourse)

The last of these is relevant to this strategy. QCC (2010) states:

The Queanbeyan River is a water course constituting a significant natural feature and recreation base within the City of Queanbeyan. It provides the community with a range of aquatic based recreational opportunities, and has significance in terms of wildlife habitat. The river corridor presents the community with an unequalled opportunity to combine urban amenity, active and passive recreation with a naturally occurring aquatic wildlife corridor.

Relevant objectives and performance targets identified in the QCC (2010) plan are incorporated in **Section 4** of this Riparian Corridor Strategy.

2.4 OTHER PLANS AND POLICIES

Water sharing plans

Water sharing plans (WSP) made under the WM Act establish rules for sharing water between the environmental needs of the river or aquifer and water users, and also between different types of water use such as town supply, rural domestic supply, stock watering, industry and irrigation. The draft Murrumbidgee WSP (which covers the Queanbeyan River) is currently before the Minister (pers. comm. Danielle Dougherty, NSW Office of Water 27/7/11). Its objectives include protection of the health of rivers and groundwater while also providing water users with perpetual access licences, equitable conditions, and increased opportunities to trade water through separation of land and water. Due to the formation of this plan, water sharing issues are not addressed in the Queanbeyan River Riparian Corridor Strategy.

State Weirs Policy 1997 NSW Fisheries

Since the late 1990s NSW Fisheries (now NSW DPI) has been encouraging weir removal as a management tool to address river degradation through the *State Weirs Policy*. There are 350 weirs in the Murrumbidgee CMA region, including a number of weirs on the Queanbeyan River. In accordance with the *State Weirs Policy*, all weirs on the Queanbeyan River should be assessed for their potential impact on aquatic habitat. Any recommendations for modification (such as the instalment of fishways) will need to be consistent with Water Sharing Plans for the region.

In 2006, the Murrumbidgee CMA investigated thirty weirs in the Murrumbidgee catchment and selected seven State Water owned weirs for detailed review. The report recommended construction of fishways at those seven weirs. Additional detailed investigation is needed regarding the other weirs in the region.

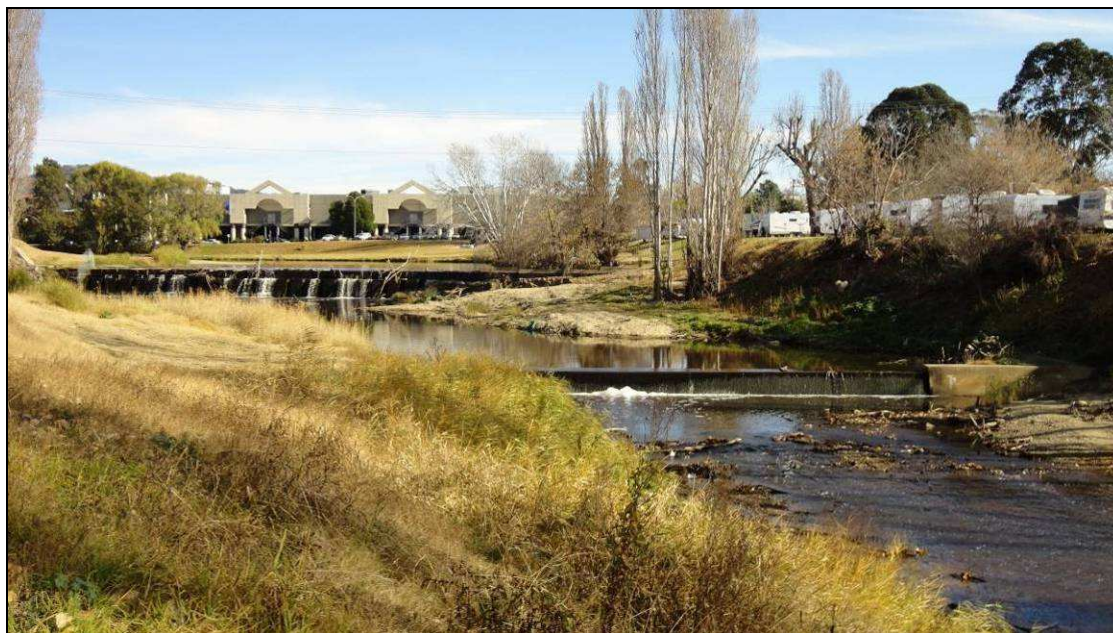


Photo: Two weirs near the Queanbeyan CBD

ACWA Program in Upper Murrumbidgee

The Action for Clean Water (ACWA) program was established in response to increased turbidity within the Upper Murrumbidgee River as well as the poor ecosystem health noted in the *2008 Murray Darling Basin Sustainable Rivers Audit*. It aims to enhance surface water quality and reduce turbidity in the Upper Murrumbidgee River catchment in NSW and the ACT.

The program encourages a collaboration of federal, state and local government agencies, research scientists and other stakeholders within the catchment. Queanbeyan City Council is represented on the ACWA Advisory Group. The program may be expanded to include the Queanbeyan River catchment.

The first plan is scheduled to be completed by mid 2012. It will prioritise regions for scientifically based best management practices including actions such as revegetation, bank stabilisation, in stream structural works, fencing and landholder education.

3 History and features of the corridor

3.1 CLIMATE

Queanbeyan (35.36 °S, 149.23 °E) has an elevation of 580 m. Temperatures range from an average maximum monthly temperature of 29°C in summer to average minimum monthly temperatures of –2°C in winter. Rainfall averages are higher in summer than in winter, with an average annual rainfall of around 600 mm.

The following climate changes are predicted for Queanbeyan (Sutton et al 2008):

- Increase in temperature; more hot days and warm nights
- Reduction in annual rainfall and increased likelihood of drought
- Increased intensity of daily rainfall events, more intense storm events
- Increased likelihood (frequency and intensity) of bushfire
- Fewer frost days

Consequences of predicted climate change on water availability and biodiversity are outlined below. Potential adaptation and mitigation measures relevant to the Queanbeyan River are discussed in **Section 4**.

3.2 GEOLOGY AND SOILS

Elevation in the catchment ranges from 550 m to 1,000 m above sea level. Most of the terrain near the river is hilly to undulating (NECS 1997). The Queanbeyan River has formed a minor gorge, with erosion of limestone deposits creating escarpments such as those seen at White Rocks.

The Queanbeyan region is dominated primarily by folded and faulted Ordovician metasediments and Silurian age volcanic sediments (NECS 1997). Soils are generally shallow, stony and relatively infertile, with deeper, more fertile soils occurring on flats and valley bottoms (ACT Environment Commissioner 2006). Limestone deposits are located in the region with several seams along the eastern bank of the Queanbeyan River. Alluvium is confined to riverbeds and adjacent terraces with minor amounts of alluvial gold previously found (NECS 1997).

The Molonglo Catchment Group has prepared a series of maps for the *Molonglo Catchment Strategy 2004-2024*² that indicate, on a catchment-scale, the study area experiences:

- Minor gully erosion (<1.5 m deep) in the undeveloped areas of the upper catchment
- High soil erosion hazard for non-concentrated flows in developed areas
- Low soil erosion hazard for non-concentrated flows in undeveloped areas

Although unmapped by the Molonglo Catchment Group, tributaries and sections of the main channel in the mid and lower catchment also experience gully erosion.

² http://www.molonglocatchment.com.au/catchment_planning.htm



Photo: Minor soil erosion on slope between the river and southern end of Collett Street



Photo: Previously rehabilitated tributary near the Suspension Bridge requiring follow-up erosion and weed control

3.3 HERITAGE

3.3.1 Indigenous history

Evidence of Aboriginal occupation in the region has been dated to approximately 20,000 years ago. Rivers and floodplains in the area would have provided sources of food in the form of fish, shellfish, water fowl and edible roots, as well as grazing animals such as emus, kangaroo and wallaby.

Boot & Kushie (1996) concluded that the region around Jumping Creek and the Queanbeyan River was likely to be frequently inhabited by indigenous people. Evidence for this is supported by more than twenty sites recorded in the Jumping Creek area containing quartz artefacts and blades.

Further evidence of indigenous use of the land was found in an archaeological survey of the Gale precinct (Hogg 1991), which identified nine sites including a scarred tree and campsites. The location of sites and artefacts was mainly restricted to ridgelines and spurs that were probably used as access routes to creek corridors.

In a report on the rezoning of the Gale precinct, Birtles (1995) stated that the Queanbeyan River valley has spiritual value for the Aboriginal people, with the river being part of the Dreaming Track, linking the coast to inland Australia. The report also identified White Rocks as a sacred ground.

There is a need for a comprehensive study to identify Aboriginal sites and places of significance in the Queanbeyan River corridor. The study should incorporate consultation with the local Aboriginal community and refer to research conducted by students at the Australian National University. This information could be used to identify areas that need protection or areas that may be suitable for improving the wider communities' appreciation of indigenous history and values.

3.3.2 Early settlement

Graziers began to settle the region in the 1820s. The town of Queanbeyan was gazetted in 1838 and proclaimed a municipality in 1885. The name of the town is believed to be derived from the Aboriginal word for 'clear water' and was adapted by the first squatter, Timothy Beard, who named his property 'Quinbeane'.

Large swathes of native vegetation along the river near the township were cleared during early settlement, as shown in the photos below. Such clearing would probably have resulted in significant sedimentation of the river and loss or degradation of habitat.



Photos: View of township (from area near existing golf club) c.1905 (left); First bridge c.1870 (right)

The river was an important resource during early settlement. Activities that directly relied on the river included water supply for general use and for a brewery, flour mills, market gardens, and an open cut gold mine that drew water from the river (NECS 1997). Swimming and fishing were popular recreational pastimes.

River crossings were a key issue in the growth of the town. Pedestrian access across the river was first established at the current site of the suspension bridge in the form of stepping stones, and further upstream from Dodsworth Street to Hirst Avenue. The main bridge underwent four major constructions and relocations between 1848 and 1975 (NECS 1997).

Over the years, much of the early infrastructure has been lost due to floods, fire and deterioration. However, the Queanbeyan community and Council actively conserve and promote the remaining heritage. As indicated in **Table 2**, bridges are the most significant listed heritage features preserved in the riparian corridor. Other items of heritage value in the corridor include lime kilns at White Rocks, mining sites, buildings and cemeteries (Armes 1997).

Table 2: Significant listed heritage items

ITEM	VALUE	LISTING BY
Suspension Bridge over Queanbeyan River at Isabella St	Suspension bridge across the river was originally constructed of timber and cable in 1901 to replace a series of stepping stones across the Queanbeyan River. The original bridge washed away in the floods of 1925 and was replaced in 1938	Australian Heritage database under the Register of the National Estate (http://www.environment.gov.au/cgi-bin/ahdb/search.pl). (Note that the RNE was closed in 2007 and is no longer a statutory list but is maintained as a publicly available archive)
Queanbeyan railway bridges over the Queanbeyan and Burbong Rivers; part of the Goulburn-Bombala Railway	The railway was built in 1887, associated with the Cooma Railway. It is significant due to the truss formation (DSEWPC 2011, Heritage NSW 2011)	NSW Heritage Act by the Heritage Council (www.heritage.nsw.gov.au)

3.4 WATER MANAGEMENT

The Queanbeyan River is 120 km long and the section that passes through the Queanbeyan LGA (and is the subject of this plan) is 12 km long. **Figure 5** shows features relating to water management including weirs, the extent of the one in 100 year flood event, main stormwater inflows and water quality monitoring locations.

3.4.1 Weirs and dams

The Queanbeyan weir (near Queen Elizabeth Park) was constructed in 1901-2 to provide a pool for the town's water supply, and was raised an extra one metre to the height of 4 m in 1952. A second weir was subsequently built some 100 m downstream.

Googong Dam is located about 5 km upstream of the town of Queanbeyan and was built in 1977. It has a capacity of 124,500 ML. It is owned by the Commonwealth Government and operated under lease by ACTEW, the ACT's electricity, water and gas utility provider. Management is in accordance with the Commonwealth *Canberra Water Supply (Googong Dam) Act 1974*.

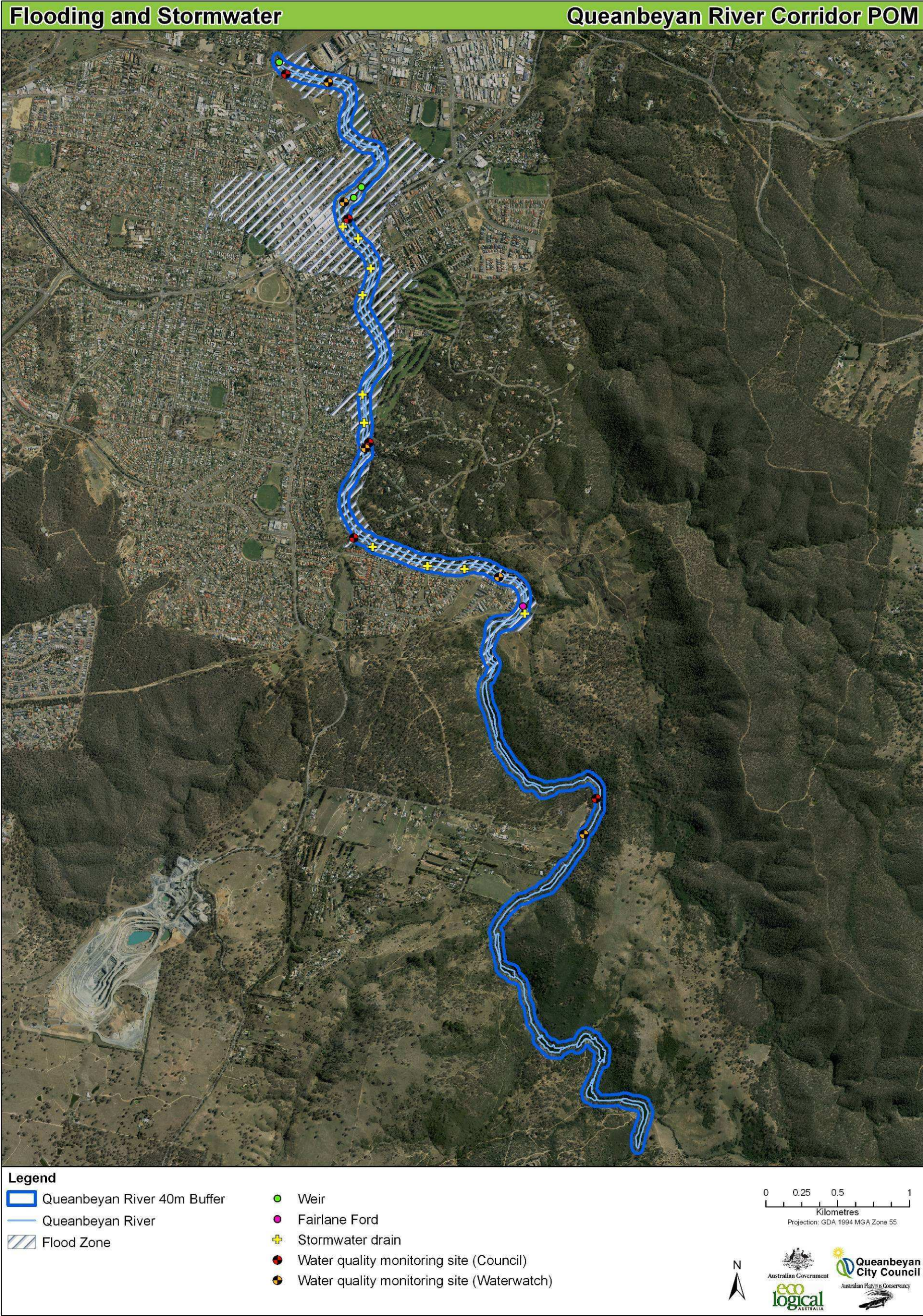


Figure 5: Flooding and stormwater

Weirs and dams regulate the flow for water supply, and affect water quality, flood regimes and aquatic habitat. For example, NECS (1997) reported that between 1977 and 1997 Googong Dam reduced base flow in the river at the Wickerslack Lane gauging station from 1 m³/s to around 0.1 m³/s. Weirs and dams along the Queanbeyan River have assisted colonisation and growth of willows and aquatic weeds, and have prevented or limited movement of fish, platypus, macroinvertebrates and other aquatic organisms.

The introduction of 'environmental flows' from Googong Dam in the 1990s aimed to simulate moderate flow regimes which would facilitate natural processes within the river and maintain healthy ecosystems. The ACT 2006 guidelines for environmental flows improved on previous policy by recognising that flow conditions should not be constant, providing a variety of minimum flow regimes for various ecological conditions. The *Draft Environmental Flow Guidelines* (ACT Government 2011) are a revision of the 2006 Environmental Flow Guidelines, updated using scientific knowledge gained during the past five years. They set out the environmental flow requirements needed to maintain aquatic ecosystems (refer to **Section 4.2.2** for further details).

The two main weirs in Queanbeyan were examined in a catchment wide weir review by NSW DPI in 2002. It was recommended that a fishway be considered for Queanbeyan weir (furthest upstream – owned by State Water). It was also recommended that investigations be made into the feasibility of modifying the sewer/weir 50 m downstream to allow fish passage. However, the upstream weir should not be removed because of the positive affect pooled water has on the amenity of Queanbeyan as well as the river's ecology (e.g. habitat for platypus and water rats). Recent advice from DPI Fisheries recommends investment in fish restocking rather than removal of the weir and/or construction of a fishway.

3.4.2 Water licences

There are 24 surface water licences within the Queanbeyan River catchment downstream of Googong Dam, including eleven located in the Queanbeyan River corridor. There are over seventy groundwater bore licences in the catchment, with the majority being for basic rights purposes (i.e. stock and domestic use). Both current and future water licence entitlements will be assessed under the Water Sharing Plan for the Queanbeyan River (draft plan currently being considered by the Minister).

3.4.3 Stormwater and sewer

Stormwater infrastructure associated with urban development includes drains and gross pollutant traps (GPTs). Sewerage infrastructure along the corridor includes reticulated systems in the town (linked to the treatment plant) and on-site disposal (e.g. septic) in the semi rural areas. Stormwater and untreated sewage contribute to pollution of the river and tributaries (e.g. nutrients, hydrocarbon and faecal organisms). Water quality is also affected by inputs from properties directly adjoining the river (e.g. fertiliser).

There are a number of GPTs along the river (e.g. end of Rutledge Street, off Collett Street, upstream of the Queens Bridge). These traps are designed to prevent solid waste from entering the waterways. The GPTs are currently cleaned on a six month cycle, around December and June each year. To be more effective, it would be preferable if the GPTs are emptied immediately after significant rainfall events, rather than leaving them for extended periods of time.

3.4.4 Flooding and drought

The river is affected by cycles of floods and droughts. As outlined in **Section 3.1**, droughts and extreme weather events are expected to be more frequent in future. Bates et al (2003) predicted that annual runoff in the Queanbeyan catchment may decrease in response to climate change by up to 20% by 2030 and up to 50% by 2070, comprising:

- changes in summer/autumn runoff of +5 to –20% and +10 to –50% by 2030 and 2070 respectively, relative to 1990
- changes in winter/spring runoff by –5 to –20% and –10 to –50% by 2030 and 2070 respectively, relative to 1990

As a consequence, water users within the catchment may face long-term reduction in allocations and higher prices for water. Ecosystems and amenity would also be affected.

During the most recent drought, Council observed households replacing natural grassed areas with paths and pavers. This has the following consequences:

- A slower rate of groundwater recharge, as a result of impervious surfaces
- The likelihood of local flooding, as a result of the stormwater system being unable to handle the runoff in a timely fashion
- Increased demand for Council resources to clear drains (Sutton et al 2008)

On the other hand, to address risks associated with flooding, Council is preparing a flood management plan in accordance with the NSW Government's Flood Prone Land Policy, as detailed in the *Floodplain Development Manual* (NSW Govt 2005), and the requirements of current legislation governing the management of vegetation and floodplains.

Heavy rainfall in December 2010 resulted in river levels reaching 8.4 m, the largest flood event since 1976. Parts of the river burst its banks, with waters dividing the CBD (see photo below taken by the SES on 9th December 2010). This event was significant in moving sediment, pollutants and debris. Some long-time residents of the area have commented that since the 2010 flood, and with the willow removal works, the channel more closely resembles the river prior to construction of Googong Dam.



Photo: Flooding across Morisset Street bridge in December 2010 (Source: SES)

3.4.5 Water quality

Council monitors water quality at seven sites (identified in **Figure 5**) each month for a variety of parameters (temperature, conductivity, pH, dissolved oxygen, nutrients and microbiological indicators of pollution). Results of the monitoring program are reported annually in Council's *State of the Environment Report* (SOE), with results being compared against ANZECC guidelines. Council has been monitoring the river since 2000.

Under the Waterwatch program, the Molonglo catchment group uses Council's database and results of volunteer sampling to provide reports on the catchment's health. Watchwatch monitoring sites within the study area are shown on **Figure 5**. Watchwatch has also been monitoring the river every year since 2000.

According to Council's 2007 SOE report and the *Molonglo Catchment Health Indicator Program Report* (Skinner 2010), water quality in the river is generally rated as good, although the nutrient concentrations have increased since 2000. Excessive nutrients within waterways can lead to algal blooms and facilitate growth of aquatic weeds. The monitoring results also indicate several instances where faecal coliform (*E.coli* and *Enterococci*) counts are extremely high which would pose issues for human health.

Macroinvertebrate populations within the upper stretches of the river are healthy with high diversity and abundance. Communities exhibited impairment further downstream, and are severely to extremely impaired at the junction with the Molonglo River (Waterwatch 2009).

3.5 ECOLOGY

The study area represents a significant ecological corridor that facilitates wildlife movement. It supports a variety of habitats for native flora and fauna species, including the Platypus (*Ornithorhynchus anatinus*) and a number of threatened species and endangered ecological communities. However, the ecological value of the corridor has been degraded by pollution, construction of weirs and dams, vegetation clearance, weed invasion, pest fauna species and inappropriate fire regimes.

The *Native Fish Strategy for the Murray-Darling Basin 2003-2013* estimated that fish populations in the Basin are only 10% of what they were prior to European settlement. Fish populations have declined because of river regulation, in-stream habitat loss, cold water pollution, alien species, barriers to fish passage, disease and riparian clearing. These issues need to be addressed if rivers such as the Queanbeyan are to support a large and diverse population of aquatic species.

The following information about the ecological characteristics of the river corridor and surrounds has primarily been taken from BES (2008) and Rowell & Crawford (1997).

3.5.1 Vegetation communities

Prior to European settlement, vegetation in the study area would have probably comprised riparian vegetation consistent with remnants now found in the upper catchment. Much of the mid- to lower part of the corridor has been cleared of native vegetation to allow rural and urban development.

The distribution and types of vegetation communities within and surrounding riparian corridor are indicated in **Figure 6**. BES (2008) identified four communities within the corridor (Native Grassland, Box-Gum Woodland, Grassland-Woodland Mosaic and Dry Forests), which are discussed below. The integrity of the vegetation communities ranges from poor (highly modified) to pristine (unmodified with structural and functional integrity intact).

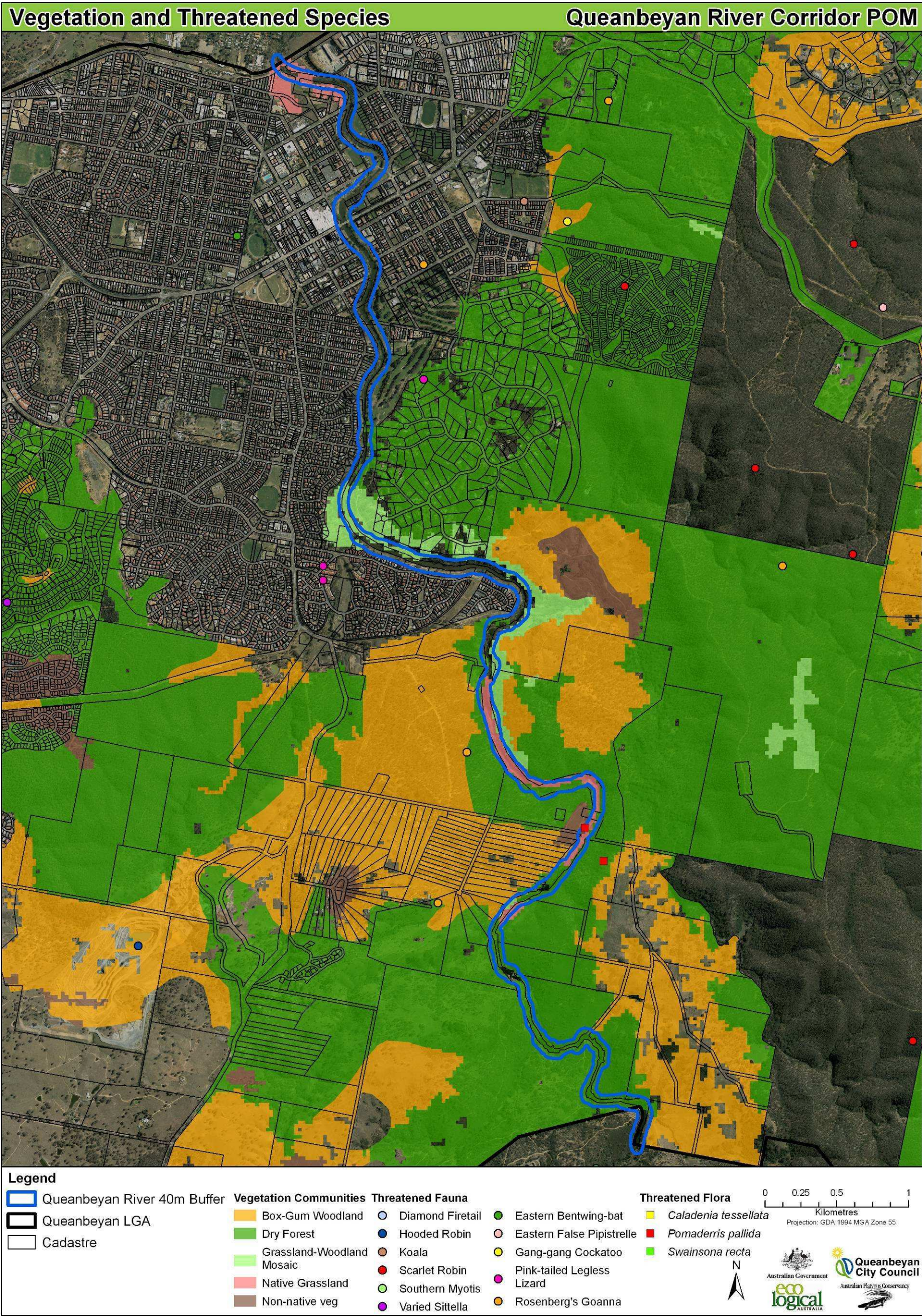


Figure 6: Vegetation communities (BES 2008) and threatened species (approximate locations)

Native Grassland

Native Grassland occurs sporadically along the entire stretch of the Queanbeyan River corridor. There are patches of the community located around Queanbeyan city, a 2 km stretch along the middle section and a very small patch in the upper reaches of the river. This vegetation type is generally subject to poor soil drainage and cold air drainage, and may be fringed by woodland in some areas. This community comprises the Natural Temperate Grasslands of the Southern Tablelands of NSW and ACT (NTG) – an endangered ecological community (EEC) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Grassland – Woodland Mosaic

The Grassland-Woodland Mosaic community within the riparian corridor is located in the middle and upper sections of the river, fringing the Native Grassland community. Parts of the community comprise the NTG and Box-Gum Woodland EECs. The Grassland – Woodland Mosaic typically comprises a mosaic of Native Grasslands and cold climate woodland communities that can include Snow Gum (*Eucalyptus pauciflora*), Manna Gum (*E. viminalis*), Apple Box (*E. bridgesiana*), Candlebark (*E. rubida*) and also areas of Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*) (Box-Gum) woodlands.

Box-Gum Woodland

Box – Gum Woodland is characterised by grassy woodlands with a tree cover of between 10 and 30 % and dominated by tree species including White Box (*E. albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*) (Fallding 2002). This community occurs on the deeper soils of the foot-slopes and mid-slopes, and occasionally on upper-slopes in the Queanbeyan LGA. Within the river corridor the community exists primarily within the middle sections of the river. Parts of the community comprise the Box-Gum Woodland ECC listed on both the NSW *Threatened Species Conservation Act 1995* (TSC Act) and EPBC Act.

Dry Forest

Dry Forest dominates the upper section of the riparian corridor, but also exists along the middle section of the corridor. This community typically comprises forests and woodlands dominated by one or more of the following eucalypt species; Red Stringybark (*E. macrorhyncha*), Red Box (*E. polyanthemos*), Scribbly Gum (*E. rossii*), Brittle Gum (*E. mannifera*), Broad-leafed Peppermint (*E. dives*), Bundy (*E. sgoniocalyx*) and Mealy Bundy (*E. nortonii*). The understorey is often sparse and dominated by tussock grasses such as Red-anthered Wallaby Grass (*Jaoycea pallida*). Dry Forests typically occur on shallower soils and steeper slopes than those that support grassy woodlands. This community includes those parts of the Box-Gum Woodland community where Yellow Box (*E. melliodora*) is not dominant or co-dominant.

Endangered Ecological Communities

In summary, three EECs are known to occur within the Queanbeyan River corridor:

- Natural Temperate Grasslands of the Southern Tablelands of NSW and ACT (EPBC Act) (Natural Grassland)
- White Box, Yellow Box, Blakely's Red Gum Woodland (TSC Act) (Box-Gum Woodland)
- White Box, Yellow Box, Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands (EPBC Act) (Box-Gum Woodland)

The Box-Gum Woodland EEC is covered by listings at both state and federal level, which each have slightly different definitions of the community. For the purposes of this report the Box-Gum Woodland EEC has been defined using the NSW definition and includes recent changes proposed by the OEH for identification of the community.

3.5.2 Iconic fauna

As part of this strategy, the Australian Platypus Conservancy has prepared the *Platypus Awareness and Conservation Strategy* (**Appendix B**). The strategy focuses on iconic fauna species inhabiting the Queanbeyan River corridor – the Platypus (*Ornithorhynchus anatinus*) and Australian Water Rat (*Hydromys chrysogaster*). The Platypus is an important biological component of permanent freshwater ecosystems in south-eastern Australia and is a popular conservation icon.

3.5.3 Threatened species

Threatened species recorded in the study area are indicated in **Figure 6** (locations shown on the map are approximate only, as determined by the accuracy of field and mapping techniques). Several areas along the riparian corridor have high conservation value because they support a wide array of species. Threatened flora and fauna species that have been recorded in the corridor or have suitable habitat in the corridor are listed below. Their preferred habitat types are described in **Appendix H**.

Table 3: Threatened species recorded in the study area

SCIENTIFIC NAME	COMMON NAME	STATUS	
		EPBC Act (C'weath legislation)	TSC Act (NSW legislation)
<i>Aprasia parapulchella</i>	Pink-tailed Worm Lizard	✓	✓
<i>Caladenia tessellata</i>	Thick-lipped Spider Orchid	✓	✓
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo		✓
<i>Phascolarctos cinereus</i>	Koala		✓
<i>Pomaderris pallid</i>	Riverine Pomaderris	✓	✓
<i>Pyrholaemus sagittatus</i>	Speckled Warbler		✓
<i>Maccullochella peelii peelii</i>	Murray Cod	✓	
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing Bat		✓
<i>Varanus rosenbergi</i>	Rosenbergs Monitor		✓

Threatened species that have been identified in the broader region (by the NSW Wildlife Atlas and EPBC Act Protected Matters databases) and have suitable habitat within the riparian corridor include:

- Australian Painted Snipe (*Rostratula australis*)
- Barking Owl (*Ninox connivens*)
- Diamond Firetail (*Stagonopleura guttata*)
- Hooded Robin (*Melanodryas cucullata*)
- Masked Owl (*Tyto novaehollandiae*)
- Powerful Owl (*Ninox strenua*)
- Superb Parrot (*Polytelis swainsonii*)

3.5.4 Key threatening processes

Key threatening processes listed under the TSC Act, the EPBC Act and FM Act that may affect species found within the corridor include:

- The removal of large woody debris, dead wood and dead trees from rivers and streams
- Clearance or degradation of native riparian vegetation along water courses
- Loss of hollow-bearing trees
- Installation and operation of in-stream structures and other mechanisms that alter natural flow regimes of rivers and streams
- Bushrock removal
- Ecological consequences of high frequency fires
- Invasion, establishment and spread of Lantana (*Lantana camara L. sens.*)
- Competition and grazing by the feral European rabbit
- Predation by the European Red Fox
- Predation by feral cats
- Invasion and establishment of exotic vines and scramblers
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants

Additional threats to individual species or communities are as follows³:

- Continuous heavy grazing and trampling of remnants by grazing stock, impacting both vegetative communities and fauna
- Application of intense defoliation regimes, in particular, too frequent burning or slashing
- Physical compaction of the soil, by people, stock and vehicles
- Chemical changes to the soil by the application of fertilisers and lime, or from run-on of nutrients from adjacent sites
- Altered soil moisture conditions, including modified drainage
- Salinity and the associated remediation for salinity (i.e. exclusion of stock and tree planting)
- Harvesting of firewood (either living or standing dead, including material on the ground)
- Collection of on-ground woody debris in the guise of a 'clean-up'
- Habitat degradation through slashing for hazard reduction, ploughing and rock removal
- Modification of habitat through tree-planting in native grasslands
- Moving vehicles pose threats to native fauna
- Non-application of biomass control measures in some highly productive sites, which leads to over-shading by dominant grasses (particularly Kangaroo Grass), shading out of associated forbs, and ultimate loss of vigour of the dominants, which in turn can result in mobilisation of nutrients locked up in the dominant grass sward, which leads to weed invasion

Noxious and environmental weeds present a serious threat to the ecology, productivity and amenity of the corridor. Noxious weeds that are listed under the *Noxious Weeds Act* for the LGA are in **Appendix I**.

³ Threatened species profiles for species, populations and communities listed under the TSC Act (<http://www.threatenedspecies.environment.nsw.gov.au/tsprofile>)

Climate change also presents a threat to ecosystems in the corridor. Decreases in runoff due to climate change may have a negative impact on aquatic biodiversity and riparian/wetland ecosystems. Plants and animals may become 'stranded' in isolated remnants of vegetation as climate zones change, due to a lack of suitable habitat for migration. More frequent droughts and fires are likely to increase stress on plants and animals. (CSIRO 2006)

3.5.5 Recovery planning

Information relevant to recovery of species and ecological communities in the corridor is available from the following sources, and these have been considered when developing actions for this Riparian Corridor Strategy (**Section 4**):

- Threatened species profiles for species, populations and communities listed under the TSC Act (<http://www.threatenedspecies.environment.nsw.gov.au/tsprofile>)
- DECC 2007. *NSW Threatened Species Priority Action Statement (PAS)*
- Threatened species profiles for species, populations and communities listed under the EPBC Act (<http://www.environment.gov.au/epbc/protect/species-communities.html>)
- Key threatening processes for species, populations and ecological communities listed under the TSC Act (http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/home_threats.aspx)
- Key threatening processes for EPBC Act listed species, populations and communities (<http://www.environment.gov.au/cgi-bin/sprat/public/publicgetkeythreats.pl>)
- National Murray Cod Recovery Team 2010. *National Recovery Plan for the Murray Cod *Maccullochella peelii peelii**. Department of Sustainability and Environment, Melbourne.
- MDBA 2004. *Native Fish Strategy for the Murray-Darling Basin 2003-2013*. MDBC, Canberra.
- It is noted that in late 2011, 150 Chinese elm trees (*Ulmus parvifolia* - an introduced deciduous species) were planted along the river corridor at Trincolo Place. This action is inconsistent with ecological recovery objectives, plans and policies. Many of these trees will need to be relocated outside the riparian buffer zone. Significant works planned to occur within 40 m of the river bank must be coordinated in consultation with Council's Environmental Advisory and Sustainability Committee.

3.5.6 Recent recovery effort

Activities performed in recent years to help rehabilitate the ecological value of the corridor include revegetation and weed control, aquatic plant control and restocking with native fish.

Revegetation and weed control

Willows have been established within the Queanbeyan River landscape for over 100 years, dominating the riparian corridor since the establishment of Googong Dam in 1977 (Lang 2000). They are deemed an environmental weed due to their ability to spread and quickly dominate the riparian zone, posing threats to native vegetation, water quality, sedimentation and bank erosion. The detrimental impacts of willows and need for their removal was acknowledged as a priority action in the 1999 *Queanbeyan River Corridor Plan of Management*, with subsequent reports recommending a 'top down' approach of willow removals (Lang 2000).

In 2008, the Queanbeyan River Traditional Owners Restoration Project was established to make further environmental improvements following willow removal efforts. The project focused on restoration of the Queanbeyan riparian corridor from Barracks Flat Creek to the low level bridge though removal of willows, other weeds and revegetation with locally propagated native species (refer to list in **Appendix J**). The program saw a partnership between the Murrumbidgee CMA and the QCC, and was also supported by local Aboriginal groups, TAFE NSW, and the NSW and Federal Governments.

By 2011, the majority of willows have been removed from the river's edge, with monitoring and maintenance of vegetation within the riparian zone now becoming a priority to ensure the spread of other noxious and environmental weeds does not occur.

Aquatic plant removal

Aquatic plants play an important role in the ecosystem of the river environment. They provide habitat for a variety of vertebrate and invertebrate species, increase biodiversity, decrease bank erosion and act as natural filters for fine sediment and nutrients. In response to the 1997 River Corridor Study, QCC developed a management plan for aquatic plants on the Queanbeyan River Weir Pool. This strategy deals with the removal of aquatic plants for public safety, aesthetic and water flow issues. The management plan's objectives are to selectively cull aquatic plants and limit the growth in various areas in accordance with the 1997 River Corridor Study and the Native Fish Stocking Program.



Aquatic plant removal



Revegetation and path construction

Native fish populations

Council conducted fish surveys in 1998, 2001, 2004 and 2011 using funds provided by ACT Wildlife and Research. Species that have been released into the river since 2000 by the Department of Primary Industries and/or Council under a restocking program for the Murray-Darling system include:

- Macquarie Perch (*Macquaria australasica*)
- Golden Perch (*Macquaria ambigua*)
- Silver Perch (*Bidyanus bidyanus*)
- Murray Cod (*Maccullochella peelii peelii*)

Council held a 'catch a carp competition' in 2001 to help reduce numbers of this pest species. There were 400 entrants to the competition and 75 fish weighed in.

The total number of fish recorded in 2011 was less than previous surveys (

Table 4) due to the reduced number of sampling techniques used, Oaks Estate not being sampled and the likelihood of fish migrating downstream during the December 2010 flood. Golden Perch was the only native angling species captured in 2011. An opportunity exists to augment the native fish population by continuing to stock the Queanbeyan weir pool with Golden Perch and Murray Cod while there are adequate flows in the Queanbeyan River below Googong Dam and numbers of Redfin are relatively low.

Table 4: Results of fish monitoring 2004-2011

YEAR (SHOTS)	GOLDEN PERCH	REDFIN	CARP	TOTAL
2004 (20)	1	23	3	27
2005 (10)	-	1	6	7
2006 (24)	-	31	18	49
2007 (10)	-	10	1	11
2011 (24)	4	7	6	17

Source: Queanbeyan City Council (N. Abbott pers. com.)

3.6 BUSHFIRES

Inappropriate fire regimes are considered a threat (DEC 2004; Environment ACT 2005) to the endangered ecological communities in the study area, i.e. White Box Yellow Box Blakely's Red Gum Woodland and Natural Temperate Grasslands of the Southern Tablelands of NSW and the ACT.

Bushfire can also have substantial impacts on aquatic ecology and river health, particularly if heavy rainfall occurs after significant fires. The impacts of flooding after bushfire include general reduction of water quality such as addition of nutrients to the waterway, sedimentation, increased turbidity and reduction of dissolved oxygen within the water column. Such impacts pose a serious threat to fish and aquatic invertebrates within the river and can cause algal blooms.

The impact of potentially toxic effects from bushfires is poorly understood in Australian aquatic ecosystems (EPA 2004). Substantial bushfires in the upper catchment of the Queanbeyan River are also likely to impact the hydrology of the river. Until natural vegetation re-establishes, the soil's capacity to hold water is quickly exceeded in heavy rainfalls resulting in increased flow and sedimentation of the river.

The intensity and frequency of bushfires are expected to increase with predicted climate change.

3.7 RECREATION AND ACCESS

The Queanbeyan River corridor provides significant recreational opportunities within the region, as tabulated below and shown in **Figure 7**. Community feedback received during preparation of this strategy indicated a high degree of support for actions to improve recreational amenity, particularly walking/cycling loop tracks of varying lengths, while maintaining and improving environmental conditions. Comments in the following table provide a background to existing conditions and the issues highlighted during consultation.

Table 5: Recreation and access

TYPE	LOCATION & COMMENT
Swimming	Swimming occurs in the river but is not encouraged because of public safety risks
Canoeing/kayaking	Boating activities are more popular since the willows have been removed and the 2010 flood occurred. There are opportunities to involve canoeists/kayakers in on-river rehabilitation activities
Fishing	Fishing is a popular activity along the river, particularly since the willows have been removed. Need education and signage regarding fish species and sizes, habitat protection and improvement, and risks (e.g. entanglement of native species such as platypus)
Sealed path / cycleway & unsealed tracks	Concrete paths have been constructed along parts of the river's edge near the town centre. Unsealed tracks are available on the southern bank of River Reserve further upstream to the edge of the urban area There was strong community interest in the issue of public access along the river corridor, particularly between Glebe Park and Dane St
Playgrounds & BBQ/formal picnic	Barrack Flat Park - on tributary to river, has BBQ, toilets, picnic tables and bike track Blundell Park – playground Doeberl Reserve - natural area Glebe Park – fenced playground, toilets, BBQ, seating, bitumen basketball court, outdoor classroom Marj Christian Riverside Park – fenced playground, shelter, picnic tables, wood fireplaces, recent plantings with exotic tree species Queanbeyan River Recreation Reserve – playground Queen Elizabeth Park – fenced playground, BBQ, picnic tables, seating River Reserve - natural area with unsealed track
Seats	Council has installed seats along the corridor to provide places for rest and views over the river; additional seating is needed There is a small outdoor classroom of seats in a bushland setting at the northern end of Glebe Park
Mown open space	Extensive areas of the riparian corridor are mown by Council; some of these areas do not appear to be utilised for recreation and may be suitable for revegetation to improve habitat and amenity, and reduce ongoing mowing costs
Sports fields	Riverside Sportsground

TYPE	LOCATION & COMMENT
	Blundell Park
Golf course	Queanbeyan Golf Course is situated adjacent the river. Unrestricted public access is available along the river's edge, although there is a safety issue associated with golfing activities. Maintenance of the golf course involves mowing and fertilising the greens, and this may have a detrimental effect on the river
Bridges/river crossings	Queens Bridge – located on Monaro St is an elevated traffic bridge Suspension bridge – located at intersection of Isabella and Collett Streets is a pedestrian only bridge (see photo below) Low level bridge – located at Morisset / Atkinson St
Riverside cafe	The Riverside cafe is being constructed in Ray Morton Park, opposite Queen Elizabeth Park.
Relationship to CBD	The CBD Master Plan (Place et al 2009) states that the Queanbeyan River and associated parklands represent a highly valuable asset within the town centre. However, the lack of integration of these within the city fabric weakens the overall amenity. Development has occurred along the river frontage (Collett Street) without taking full advantage of this aspect. Visual and physical connections to the CBD are poor with significant grade separation between Collett Street and the open space hindering pedestrian access. Queen Elizabeth Park provides a valuable respite for users and could be enhanced to create a more meaningful relationship with the CBD.



Photo: Suspension bridge

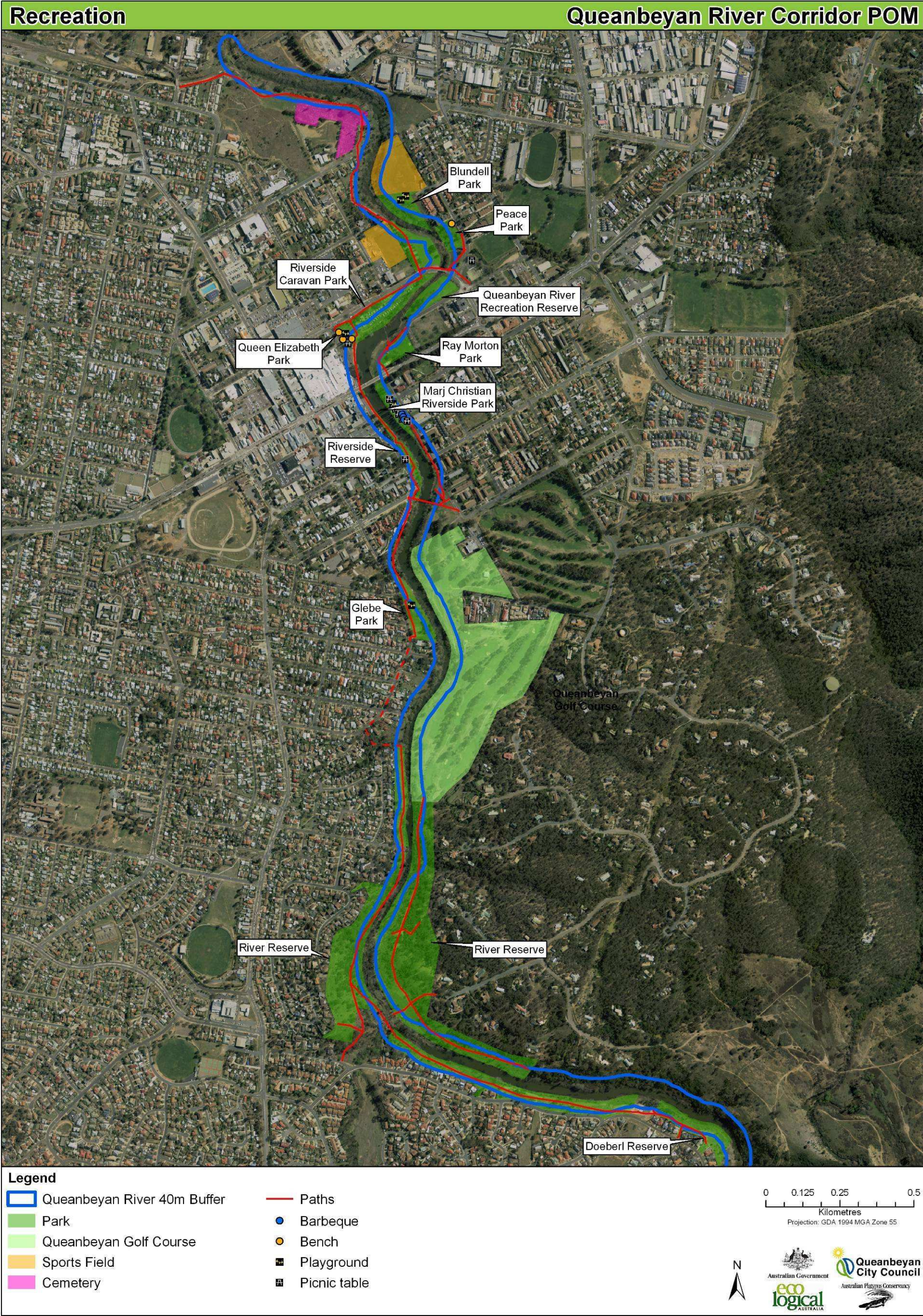


Figure 7: Recreation facilities

3.8 CARAVAN PARK

The Queanbeyan Riverside Tourist Park (the caravan park) was established by the Council on Crown land adjacent to the Queanbeyan River in the 1960s. The caravan park was operated by the Council for many years and in 1999 it leased the operation to Marellen Pastoral Company Pty Ltd for a twenty year period. At that time the on-site cabins and maintenance equipment were sold to the lessee, but the Council retains the ownership of the caravan park infrastructure, including the amenities building, sheds, park furniture, roads and site infrastructure.

The lessee has a legal and legitimate right to operate the park until the expiration of the lease on 28 February 2019. It is the role of the Trust Manager (the Council) to determine any request for a lease extension and the NSW Department of Primary Industries (Crown Land Division) will be guided by that position.

3.8.1 Current status and management

Facilities

The caravan park was established in the 1960s, and its infrastructure requires upgrading. Examples are:

- The size of the caravan park is 1.17 ha, which only just exceeds the 1 ha minimum requirement
- The forecourt area is approximately 7 m too short
- Road widths for two-way traffic are required to be 6 m; within the caravan park the general road width is only 5 m
- Access to sewerage is not provided for all sites
- Some sites do not have direct access to power; it has been observed that power has been provided to some sites by using extension leads across internal roads
- The proximity of some dwelling sites to park amenities exceeds the maximum distance allowable of 100 m

For licensing purposes, limitations and non complying features can be covered by an exemption that permits acceptance where facilities were in place prior to the commencement of the new requirements.

Pollution

The location of the caravan park immediately adjacent to the Queanbeyan River is a concern in respect of pollution. It has been observed that when caravans have been located on sites within the park that do not have access to sewerage facilities, sullage lines have been laid to the rear of the van with potential to flow into the river.

There are two major trunk sewer lines that service the southern part of the city that traverse the leased area to connect the sewer pumping station at the corner of Morisset and Carinya Streets. A recent sewer block in one of the lines caused a minor sewage spill and required extensive works to clear the blockage. A relief line was constructed between two access holes located in the caravan park to overcome the blockage. These works caused inconvenience to caravan park users, conflict with park management and required compensation to be paid to the caravan park because a number of sites could not be used whilst the work was undertaken.

The age and number of sewer and sullage lines within the park, as well as restricted access due to park facilities, increases the risk of river pollution if blockages or breakages occur.

There is uncertainty regarding responsibility for clean-up and management of the Queanbeyan River foreshore adjacent to the caravan park. This lack of clarity is detrimental to the amenity of the river environs.

Flooding

The caravan park site is within the floodplain of the river and is subject to flooding. The most recent event was in December 2010. The flood was assessed as a one in twenty year flood event and the caravan park flood emergency plan had to be enacted. The plan required caravans and on-site cabins to be relocated to the Queanbeyan Showground. However, the on-site vans could only be moved to an adjacent Council car park. This area would also have been inundated if the flood event was of greater intensity.

Public access

The existing location of the caravan park impedes the contiguous public use of land along the northern side of the river as the leased area is for the exclusive use of the lessee (and caravan park visitors). Accordingly, any plans to expand the parkland area, or develop community amenities and walking tracks along the river would be precluded.

The Council has endeavoured to increase the community focus on the Queanbeyan River and its foreshore, and in its CBD Master Plan there is recognition of the need to strengthen this focus. The development of walking trails on both sides of the river, and projects such as the Riverside café and the sensory gardens (to be built in 2012/13) will enhance the attraction of the foreshore for local residents and visitors to the area. Accordingly, there is a need for additional parks in the area.

3.8.2 Lessee's strategy

It is known that the lessee is keen to extend the existing lease and has offered to 'make a significant investment to upgrade the caravan park facilities in line with the CBD Master Plan in return for a new 25 year lease' (letter to Council from the Marellen Pastoral Company on 23/11/2010). The 'New Lease Strategy' for the caravan park by the Marellen Pastoral Company states that the three main strengths of the park are that it:

- Provides lower cost accommodation for the budget conscious
- Allows pets
- Is located next to the CBD and major facilities

The 'New Lease Strategy' (which has not been endorsed by Council) proposes the following investment to cater for projected growth in occupancy:

- Relocate road at south end to improve access
- More concrete slabs for vans
- Replace worn or broken concrete paths etc
- Construct six new cabins and one disabled cabin (suitable ramp, toilet etc)
- Refurbish amenities block
- Build camp kitchen and improve BBQ facilities
- Prepare landscaping masterplan
- Develop lower riverside amenity for visitors
- Replace grass areas with artificial turf
- Review all space to maximise density to site

However, the lessee will not invest in the site unless the lease period is extended.

3.8.3 Future use of the site

The Trust Manager (Council) needs to consider opportunities and threats to the river corridor as well as broader socio-economic factors when deciding the future use of the caravan park site. In summary, while it is recognised that the caravan park provides a significant economic benefit to Queanbeyan by attracting visitors to the area, and plans by the lessee to upgrade facilities could partly address issues associated with aging and non-compliant infrastructure and facilities, the riverside location is not preferred because of problems associated with pollution, flooding, public access and amenity. Council should consider a strategy to allow the current lease expire and not be renewed. The site should be converted into public parkland consistent with the vision and objectives of the CBD Master Plan and those outlined in **Section 4** of this strategy.

There may be opportunities to relocate / establish a caravan park at a more suitable location in Queanbeyan.

3.9 FUTURE DEVELOPMENT

The current population of Queanbeyan exceeds 40,000 and it is estimated that this will increase to approximately 70,000 by 2036 as a result of new developments at Googong and in the Jerrabomberra Valley. Future growth and change in the urban fabric of Queanbeyan comprises three main trends (Sutton et al 2008):

- New suburban estates on the town perimeter
- Rural residential developments on the peri-urban fringe
- Densification and infill

Some considerations associated with these land use changes include:

- Loss of vegetation and fauna habitat
- Greater water demand
- Modified stormwater conditions e.g. more impervious surfaces creating greater peak discharges
- Increased discharges of treated wastewater (sewage)
- Need for additional facilities and services (e.g. for recreation)

3.10 COMMUNITY ENGAGEMENT

The community is involved in monitoring and management of the river corridor through the following programs and activities.

Table 6: Community participation and education

TYPE	DESCRIPTION
Platypus monitoring	The Australian Platypus Conservancy (APC) coordinates community involvement in monitoring platypus and water rats with a project called <i>Platypus Count</i> . Data is used by the APC to determine population trends. New volunteers can register an interest through Waterwatch*
Waterwatch	Formed in 2003, the Molonglo Catchment section of the Upper Murrumbidgee Waterwatch group regularly monitors the water quality of the Molonglo catchment. The group produces six-monthly reports detailing the health of the Queanbeyan River utilising water and biomonitoring techniques. New volunteers can become involved in this project by contacting Waterwatch*

TYPE	DESCRIPTION
Frogwatch	Frogwatch is a community based group conducting research and surveys on frog activities. The Ginninderra catchment group conducts annual surveys of frogs within the Queanbeyan River corridor. Frogwatch works closely with members of Waterwatch groups in the area and can be contacted through Waterwatch*
Landcare	The Queanbeyan Landcare Inc group conducts Landcare activities in the Queanbeyan River corridor. The Landcare group has been partners in the willow removal project on the river and meets every month.
Education	Environmental education programs and promotions run by Council includes signage in parks and along walking tracks, and sustainable living activities (energy and water efficiency, waste minimisation etc)

*waterwatch@molonglocatchment.com.au

3.11 SUMMARY OF MANAGEMENT ISSUES AND OPPORTUNITIES

The main issues that require management within the corridor are as follows:

- Weeds including willows and aquatic plants
- Pollution sources (point source and diffuse) including rubbish dumping
- Impacts associated with adjacent land uses
- Provision and quality of public access
- Threats to water quality and hydrological regimes
- Recovery of threatened species and endangered ecological communities
- Protection of biodiversity
- Community involvement
- Climate change



Photo: Queanbeyan Regatta

4 Strategic framework

4.1 VISION

The vision for the river corridor was developed in conjunction with the community for the 1999 Plan of Management. It continues to be relevant and supported, and is:

To protect and enhance the Queanbeyan River Corridor as the focus of the City's natural and cultural environment, providing a diverse range of recreational opportunities whilst maintaining, improving and protecting the social, cultural, natural, visual and heritage landscape, for both the local and wider community.

4.2 OBJECTIVES

4.2.1 Land management objectives

Objectives for management of land within the corridor have been developed to reflect land tenure (see **Figures 2-4**) and statutory requirements. There are three broad sets of objectives for the corridor which are discussed below:

- Objectives for Council-owned community land
- Objectives for Crown reserves
- Objectives for all other land within the corridor

Council-owned community land within the corridor has been categorised in accordance with the requirements of the *Local Government Act*. Parcels of land within each category, and relevant objectives are given in **Table 7**.

Table 7: Categories and objectives for community land under the LG Act

CATEGORIES	MANAGEMENT OBJECTIVES	AFFECTED LAND*
Sportsground	<p>To encourage, promote and facilitate recreational pursuits in the community involving organised and informal sporting activities and games</p> <p>To ensure that such activities are managed having regard to any adverse impact on nearby residences</p>	Lot 2 DP 835901 (Riverside Sportsground)
Park	<p>To encourage, promote and facilitate recreational, cultural, social and educational pastimes and activities</p> <p>To provide for passive recreational activities or pastimes and for the casual playing of games</p> <p>To improve the land in such a way as to promote and facilitate its use to achieve the other core objectives for its management</p>	<p>Lot 3 DP 1021603 and Lot 6 Section 6 DP 978284 (park next to Ford St)</p> <p>Lot 48 DP 14068 (Glebe Park)</p>

Community use	<p>To promote, encourage and provide for the use of the land, and to provide facilities on the land, to meet the current and future needs of the local community and of the wider public:</p> <p>in relation to public recreation and the physical, cultural, social and intellectual welfare or development of individual members of the public</p> <p>in relation to purposes for which a lease, licence or other estate may be granted in respect of the land (other than the provision of public utilities and works associated with or ancillary to public utilities)</p>	<p>Lot 6 DP 1099164 and Lot 2 DP 749033 (new café)</p>
Natural area	<p>To conserve biodiversity and maintain ecosystem function in respect of the land, or the feature or habitat in respect of which the land is categorised as a natural area</p> <p>To maintain the land, or that feature or habitat, in its natural state and setting</p> <p>To provide for the restoration and regeneration of the land</p> <p>To provide for community use of and access to the land in such a manner as will minimise and mitigate any disturbance caused by human intrusion</p> <p>To assist in and facilitate the implementation of any provisions restricting the use and management of the land that are set out in a recovery plan or threat abatement plan prepared under the <i>Threatened Species Conservation Act 1995</i> or the <i>Fisheries Management Act 1994</i></p>	<p>Lots 3 and 4 DP 792307 (upstream of Isabella St)</p> <p>Lot 17 DP 223652 and Lot 20 DP 538743 (edge of Queanbeyan Golf Course)</p> <p>Lot 2 DP 710056 (part drainage line that connects river corridor to Thorpe Ave near Sorrell PI)</p> <p>Lots 58 and 59 DP 221948 (downstream of Dane St, parallel to Woodger Pde)</p> <p>Lot 112 DP705742 (River Reserve – north-east side of river)</p> <p>Lot 24 DP 239425, Lot 2 DP 552380, Lot 20 DP 837155, Lot 105 DP 707719, Lot 243 DP 803621, Lot 20 DP 818066, Lot 51 DP 835313 (River Reserve between Dane St and River Drive)</p>
Natural area - watercourse	<p>To manage watercourses so as to protect the biodiversity and ecological values of the instream environment, particularly in relation to water quality and water flows</p> <p>To manage watercourses so as to protect the riparian environment, particularly in relation to riparian vegetation and habitats and bank stability</p> <p>To restore degraded watercourses</p> <p>To promote community education, and community access to and use of the watercourse, without compromising the other core objectives of the category</p>	<p>Lot 39 DP 1007139 (Doeberl Reserve)</p> <p>Lot 86 DP 45240, Lots 38 and 43 DP 226218 (upstream of Barracks Flat)</p>

*Figures 2-4 show community lands

Section 11 of the *Crown Lands Act* outlines the management principles for Crown reserves such as Blundell Park:

- That environmental protection principles be observed in relation to the management and administration of Crown land
- That the natural resources of Crown land (including water, soil, flora, fauna and scenic quality) be conserved wherever possible
- That public use and enjoyment of appropriate Crown land be encouraged
- That, where appropriate, multiple use of Crown land be encouraged
- That, where appropriate, Crown land should be used and managed in such a way that both the land and its resources are sustained in perpetuity
- That Crown land be occupied, used, sold, leased, licensed or otherwise dealt with in the best interests of the State consistent with the above principles

The *Crown Lands Act* enables Crown reserves to be managed as if it were Council land in accordance with the *Local Government Act*. In Queanbeyan, Crown reserves are managed by Council.

For other areas within the corridor (i.e. private land, operational land and other Crown land which is under Council management), broad objectives for the corridor are taken from the 1999 Plan of Management as follows:

Table 8: Objectives for private land, operational land and non-reserve Crown land

VALUE	OBJECTIVE
Water quality	Improve water quality emanating from development and human activities to ensure compliance with guidelines for the protection of aquatic ecosystems and recreational waters, and achieve Sustainable environmental flows to maintain and improve the ecology and health of the river
Natural environment	Maintain, protect and enhance the natural environmental values of the Queanbeyan River and improve the value and integrity of bushland and riparian zones
Scenic quality	Preserve the views and scenic quality of the Queanbeyan River Corridor through preservation and conservation of bushland and other natural features as well as minimising the effects of urban development
Social and cultural	Maintain and enhance existing recreation areas to provide opportunities and facilities for local residents and visitors, to experience its values whilst minimising impacts on the environment
Heritage	Protect, maintain and enhance significant heritage features of the Queanbeyan River corridor including the natural bushland and individual heritage items and places
Recreation	To provide a quality recreation experience for residents and visitors to the Queanbeyan River area whilst protecting the environment
Education	Increase awareness of the ecological, recreation and heritage value of the Queanbeyan River
Resource management	To improve the effectiveness of management of the Queanbeyan River

4.2.2 Aquatic objectives

The ACT Government's *Draft 2011 Environmental Flow Guidelines* sets objectives for aquatic health and flows in the Queanbeyan River below Googong Dam. The subject area is classified as a 'water supply catchment ecosystem' and has the following objectives:

- To maintain healthy aquatic ecosystems in terms of biota⁴
- To prevent degradation of riverine habitat through sediment deposition⁵
- Maintain an average base flow of 10 ML/day or natural inflow, whichever is the lesser volume
- Maintain a riffle flow of 100 ML/day for one day every two months (no riffle maintenance flows are required during Stage 1 or 2 drought restrictions)
- Groundwater abstraction limited to 10% of the long term recharge
- No limits on drawdown levels for water supply impoundments

4.3 PRIORITIES

This strategy has a ten-year time frame. Priority for each action is rated as follows:

- High priority – to commence within two years
- Medium priority – to commence within three to six years
- Low priority – to commence within seven to ten years
- Ongoing

In **Section 4.4**, highest priority has been allocated to actions in accordance with the following principles:

- Reduce pollutant inputs to the river
- Reduce risk to public safety
- Protect and enhance biodiversity
- Maintain and improve recreational opportunities consistent with environmental improvements
- Involve the community

4.4 ACTIONS, COSTS AND PERFORMANCE MEASURES

Actions recommended in this section are consistent with the vision and objectives for the corridor. The actions have been developed in close consultation with the community, agencies and Council. Actions from recent studies (e.g. the CBD Master Plan) that have been endorsed by Council are incorporated in this Strategy.

Actions are presented in the following tables with priorities, costs and performance measures. The actions have been categorised according to the following themes:

⁴ Indicators are: Macroinvertebrate assemblages are maintained at AUSRIVAS band A level. Assessed using protocols as per the ACT AUSRIVAS sampling and processing manual (<http://ausrivas.canberra.edu.au/ausrivas>) and non-dominance (<20% cover) of filamentous algae in riffles for 95% of the time. Assessed using standardised collection and processing methods as per Norris et al (2004)

⁵ Indicator: sediment deposition is limited to <20% of total depth of pools measured at base flow using techniques per Ecovise Environmental (2005) methods

- Pollution control
- Flood management
- Education – community, Council staff, developers etc
- Access and recreational opportunities
- Rehabilitation (weed and erosion control, regeneration, revegetation)
- Planning and development
- Coordination of works
- Research and monitoring

Key actions are mapped in **Figure 8**, and further illustrated in **Appendices B** and **K**.

In summary the main actions recommended for the corridor are:

- Increase riparian habitat and amenity of the river and its tributaries through pollution reduction, erosion control, stormwater treatment, rubbish removal, weed removal, regeneration and revegetation
- Improve public access along the corridor by a network of sealed paths and unsealed tracks suitable for walkers and cyclists, allowing for circuits of variable length and condition
- Strict planning and development controls to ensure future development does not adversely affect the river corridor
- Improved coordination of rehabilitation activities within the corridor by government agencies and the community (led by Council)
- Increased community education and involvement

Cost estimates in the following tables are provided as a guide only. More accurate costs would need to be calculated prior to seeking funds.



Photo: Outdoor classroom at Glebe Park

Table 9: Pollution control actions

CODE	ACTION	PRIORITY	COST	PERFORMANCE MEASURE	COUNCIL RESPONSIBILITY
P1	Audit and offer advice on how to improve performance of privately owned on-site sewage treatment systems to reduce environmental impacts. This will continue to be done as part of Council's on-site sewage management program	Ongoing	<\$10K	Advice regarding on-site sewage treatment systems readily available to privately landholders	Environmental Health
P2	Audit the performance of the sewerage infrastructure, and investigate upgrading the plant and sewerage infrastructure in older areas	Med	<\$10K	Results of audit; report on the value of upgrading sewerage plan & infrastructure	Infrastructure
P3	Review procedures related to sewage management (e.g. pumping stations, overflows) to reduce adverse environmental impacts and risks	Med	<\$10K	Update procedures and train relevant staff	Infrastructure
P4	Maintain GPTs after heavy rainfall (rather than every six months)	High - ongoing	<\$10K p.a.	GPTs maintained after heavy rainfall	Infrastructure
P5	Install or relocate rubbish bins in easily accessible and appropriate locations (bin design to minimise risk of attracting pest fauna)	High	<\$10K	Rubbish bins available and regularly serviced	Infrastructure
P6	Liaise with the golf course managers to reduce impacts to the river from excessive fertiliser use and encroachments	High	<\$10K	Reduce fertiliser runoff and encroachments	Environmental Health
P7	Construct a barrier to prevent people from pushing shopping trolleys off the concrete ledge near the lower (Morrisett St) bridge	Low	<\$10K	Barrier constructed	Infrastructure
P8	Continue to work with the caravan park lessee regarding park and adjacent riparian management prior to end of lease in 2019	Ongoing	<\$10K	Good park and adjacent riparian management prior to cessation of the lease	Internal Business
P9	Remove unused steel poles and reposition 'unauthorized access' sign near Dane St	Low	<\$10K	Poles removed	Infrastructure
P10	Establish a River Team comprising professional bush regeneration staff to be responsible for planning and rehabilitation of the river corridor and tributaries (e.g. rubbish removal, weed control, revegetation, environmental education)	High - ongoing	>\$200K p.a.	Permanent work crew established	Environmental Health

Table 10: Access and recreation actions

CODE	ACTION	PRIORITY	COST	PERFORMANCE MEASURE	RESPONSIBILITY
A1	Investigate route for creation of an unsealed, multi-use track within or near the corridor to provide a recreational link between the track/path network associated with the urban area and Googong Dam; include public access routes from surrounding areas; close off and rehabilitate informal tracks where possible	Low	\$10-50K	Route options identified	Infrastructure
A2	Install signage to indicate the length and types of paths/tracks available	High/ongoing	\$10-50K	Signage installed	Environmental Health
A3	Install signage at the southern end of Glebe Park and the end of Dane Street to indicate the public access route between these locations; update signage if route changes	High	<\$10K	Signage installed	Environmental Health
A4	Increase appropriate community use of CBD parkland and facilities by promoting recreation and water based events (e.g. Queanbeyan Regatta)	High	<\$10K	Greater community use of CBD parkland and facilities	Community Services
A5	Investigate options for public access between Thorpe Ave and Woodger Pde Reserve	High	\$10-50K	Preferred public access route determined	Legal and internal services and Infrastructure
A6	Construct public access between Thorpe Ave and Woodger Pde Reserve	Med	>\$500K	Public access available	Infrastructure
A7	Keep the community and affected landholders informed about public access issues near Thorpe Ave	High/Med	<\$10K p.a.	Relevant parties kept informed	Legal and internal services
A8	Formalise public access through community land adjacent the golf course (Lot 17 DP 223652 and Lot 20 DP 538743) in accordance with the concept plans by dsb Landscape Architects; track should connect to existing fire trail; use suitable native plant species (Appendix J)	Med	>\$50K	Public access developed adjacent the golf course	Environmental Health
A9	Maintain the fire trail south of the golf course, including signage to prohibit unauthorized vehicle access	Ongoing	\$10-50K p.a.	Fire trail maintained in good condition	Infrastructure
A10	Construct sealed path from the low bridge to the northern end of Blundell Road, then unsealed path from Blundell Road to near the railway crossing	Low	>\$50K	Paths constructed	Infrastructure
A11	Install additional seats near path to provide resting places and views of the river	High	<\$10K	Seats installed	Infrastructure
A12	Retain some mown areas near the city centre to facilitate community events such as the Regatta and provide space for informal recreation	Ongoing	\$10-50K p.a.	Continue mowing	Infrastructure

CODE	ACTION	PRIORITY	COST	PERFORMANCE MEASURE	RESPONSIBILITY
A13	Improve access across Barracks Flat Creek; crossing design should be sympathetic to natural landscape	Med	\$10-50K	Concept design developed and crossing constructed	Infrastructure
A14	Upgrade playground infrastructure and immediate surrounds at Ray Morton Park to have gas BBQ, picnic tables, lighting, lawn area, shade trees, a shade/rain cover and exercise equipment. Playground equipment should be fenced	Med	>\$50K	Playgrounds upgraded	Infrastructure
A15	Remove wood fire places and concrete tables at Marj Christian Riverside Park	Med	<\$10K	Fireplaces and tables removed	Infrastructure
A16	Relocate / upgrade playground in Queen Elizabeth Park as per the CBD Master Plan	Low	>\$50K	Playground relocated and upgraded	Infrastructure
A17	Conduct a feasibility and scoping study for the construction of a pedestrian bridge from Queen Elizabeth Park to the River Café	High	\$10K	Study completed	Infrastructure
A18	Investigate the need for additional carparking near the River Café	Med	<\$10K	Additional parking constructed	Infrastructure
A19	Install lighting under Queens Bridge to improve public safety	High	<\$10K	Lighting installed	Infrastructure
A20	Construct deck between Queens Bridge and the suspension bridge (see CBD Master Plan); deck design to incorporate habitat features and educational signage as described in the Platypus Strategy (Appendix B)	Low	>\$50K	Bridge and deck designed and constructed	Infrastructure
A21	Construct a cantilevered boardwalk along the Queens Bridge (as per the CBD Master Plan)	Low	>\$50K	Boardwalk designed and constructed	Infrastructure
A22	Convert the existing footpath along Queens Bridge into a planted buffer (as per the CBD Master Plan)	Low	\$10-50K	Footpath converted	Infrastructure
A23	Construct a lawn amphitheatre in Queen Elizabeth Park with performance space overhanging the river	Low	>\$50K	Lawn amphitheatre designed and constructed	Infrastructure
A24	Construct deck esplanade at Queen Elizabeth Park	Low	>\$50K	Deck designed and constructed	Infrastructure
A25	Repaint Queens Bridge	Low	\$10-50K	Bridge painted	Infrastructure
A26	Install sculptures on Queens Bridge to mark gateway to/from CBD and river threshold	Med	>\$50K	Sculptures and signs installed	Infrastructure
A27	Install signs on Queens Bridge to mark gateway to/from CBD and river threshold	Med	<\$10K	Sculptures and signs installed	Infrastructure
A28	Investigate suitability of a low speed limit on roads adjacent public playgrounds and parks	Med	<\$10K	Feasibility determined	Infrastructure
A29	Formalise access to the river for boating and maintenance	High	\$10-50K	River access formalised	Infrastructure
A30	Install signage regarding fishing bag/size limits, and information about fish, platypus, water rats and other aquatic species	High	<\$10K	Signs installed	Environmental Health
A31	Investigate the location for fish cleaning tables/taps & bins with DPI (Fisheries).	Med	<\$10K	Fish tables and bins provided	Environmental Health

CODE	ACTION	PRIORITY	COST	PERFORMANCE MEASURE	RESPONSIBILITY
A32	Investigate location for disabled fishing access	Med	<\$10K	Disabled fishing access identified	Environmental Health
A33	Resolve public access at the southern end of Barracks Flat	Med	\$10-50K	Reduction of adverse impacts associated with uncontrolled access	Environmental Health
A34	Prior to the end of the caravan park lease in 2019, investigate site conditions and opportunities, and prepare a master plan to convert the site into parkland featuring pathways, native vegetation, BBQ facilities etc	Med	\$10-50K	Masterplan for the caravan park site	Environmental Health
A35	When the caravan park lease expires, remove / adapt existing infrastructure and implement masterplan for the site	Low	>\$50K	Replace caravan park with public parkland	Environmental Health
A36	Establish planted buffer zones to formalise community access along the river	High	\$50-100K	Buffer zones planted	Environmental Health
A37	Improve conditions and install signage at the outdoor classroom at Glebe Park	Med	<\$10K	Classroom suitable for use	Environmental Health

Table 11: Rehabilitation actions (weed and erosion control, regeneration, revegetation)

CODE	ACTION	PRIORITY	COST	PERFORMANCE MEASURE	RESPONSIBILITY
R1	Prepare a weed strategy which identifies and maps major weed infestations (extent, species, location) and erosion in the upper section of the corridor based on desktop assessment (aerial photos), community input and field validation, and includes any actions specified in R2 to R12 below	Med	\$10-50K	Weeds mapped	Infrastructure
R2	Develop weed control / bush regeneration plans in collaboration with other landowners and Landcare. Give priority to areas identified in the Platypus Strategy (Appendix B – with photopoints of locations) plus areas where weeds pose the greatest threat to biodiversity, erosion needs to be stabilised, areas of previous rehabilitation, areas adjacent good quality bushland with potential to expand, and areas subject to willow removal	High - ongoing	<\$50K p.a.	Detailed vegetation management plans	Environmental Health
R3	Staged rehabilitation* of the upper section of the corridor	High - ongoing	\$10-50K p.a.	Expand areas of good quality bushland	Environmental Health
R4	Staged rehabilitation* of the middle and lower sections of the main channel	High - ongoing	>\$50K p.a.	Main channel rehabilitated	Environmental Health
R5	Rehabilitate* tributaries (i.e. install stormwater controls such as GPTs and constructed wetlands, stabilise erosion, remove weeds and revegetate/regenerate). Highest priority to tributaries that have previously been subject to rehabilitation effort, are in relatively good condition and/or have community involvement	High - ongoing	>\$50K p.a.	Tributaries rehabilitated	Environmental Health
R6	Rehabilitate* middle section of Buttle Creek between High Street and Ford Street	High	>\$50K	Rehabilitated creek	Environmental Health
R7	Trial 'no mow' zones** on lower banks and slopes adjacent to the river to encourage natural regeneration; monitor closely to ensure that native species are establishing; control weeds as required; install temporary signs to indicate the aims of no mow areas	High - ongoing	<\$10K p.a.	Expand areas of natural regeneration from the river's edge	Environmental Health
R8	Liaise with local nurseries to ensure the availability of local provenance tubestock for revegetation by Council and others – consider seed collection programs as per Florabank guidelines	High	<\$10K p.a.	Suitable seeds and plants available	Environmental Health
R9	Repair stormwater drain/culvert, stabilise erosion and revegetate (opposite Dane St)	High	\$10-50K	Infrastructure repaired and landscape restored	Infrastructure
R10	Revegetate along the river bank to screen the fire trail from houses on the opposite site of the river to Dane St, stabilise erosion and improve habitat	High	\$10-50K	Area between fire trail and river rehabilitated	Environmental Health

CODE	ACTION	PRIORITY	COST	PERFORMANCE MEASURE	RESPONSIBILITY
R11	Revegetate and stabilize the bank near and below the weirs	High	\$10-50K	Bank improvements	Environmental Health
R12	If required for asset protection, only burn up to 5% of a remnant patch of EEC at a time; allow perpetually unburnt sections to act as refuges	Ongoing	<\$10K p.a.	Mosaic burns	Infrastructure
R13	Identify and prioritise all barriers to fish passage (including road crossings and culverts) for future remediation (modification/fishway construction) or removal in association with NSW DPI	Low	<\$10K	Reduce barriers to aquatic species	Environmental Health
R14	Investigate weir modification to allow for fish passage with DPI (Fisheries)	Low	\$10-50K	Concept design for weir modifications	Environmental Health
R15	Liaise with Rural Lands Protection Board to control pest fauna, including public education	Med	<\$10K	Reduce numbers of pest fauna	Environmental Health
R16	Continue restocking with native fish and enhancing native fish habitat (e.g. resnagging) in association with DPI (Fisheries)	Ongoing	\$10-50K p.a.	Increase numbers of native fish	Environmental Health

*In planning and implementing rehabilitation works, consider requirements of threatened species and EECs e.g. population of Pale Pomaderris plants; do not plant trees and shrubs in Pink-tailed Worm Lizard habitat (i.e. Native Grasslands); do not disturb rocks in Pink-tailed Worm Lizard habitat; leave fallen timber on the ground.

**No mow zones are areas where mowing is allowed to cease to encourage natural regeneration. Weed control and rubbish removal will be needed. This can be a cost-effective way to improve habitat and stabilize river banks. No mow zones should be monitored closely to determine the proportion of native species regenerating. However, if native species are not regenerating, it may be preferable to reinstate mowing until the area can be replanted with native species and follow-up weed control etc is implemented.

Table 12: Flood management actions

CODE	ACTION	PRIORITY	COST	PERFORMANCE MEASURE	RESPONSIBILITY
F1	Investigate raising the level of the eastern approach to Queens Bridge to avoid flooding	High	\$10-50K	Feasibility report	Infrastructure
F2	Finalise and adopt the Flood Management Plan	High	\$10-50K	Plan	Infrastructure
F3	Remove flood debris and willows from downstream of the low level bridge to the ACT border in a manner that minimizes adverse impacts to river stability and ecology. Revegetate the river bank with native species	High	\$300K	Debris removed and river bank stabilized	Infrastructure

Table 13: Planning and development actions

CODE	ACTION	PRIORITY	COST	PERFORMANCE MEASURE	RESPONSIBILITY
D1	Development applications and other significant activities within 40 m of the top of bank to be referred to Council's Environment & Sustainability Advisory Committee for comment. Assessment should carefully consider potential impacts to the river corridor (e.g. water quality, flows, groundwater, ecology, amenity)	Ongoing	<\$10K p.a.	Minimal impacts from development	Sustainability and Better Living
D3	Future roadwork upgrades and new crossings, culverts and bridges should take into account best management practice as outlined in the NSW DPI "Fish passage requirements for waterway crossings"	Ongoing	<\$10K p.a.	River crossings to allow fish passage	Infrastructure
D4	New infrastructure in the corridor should be designed with an architectural style consistent with the riparian landscape	Ongoing	<\$10K p.a.	Consistent architectural style applied	Infrastructure
D5	Infrastructure design should allow for the possibility of flood inundation	Ongoing	<\$10K p.a.	Minimal flood damage to infrastructure	Infrastructure

Table 14: Actions relevant to coordination of works

CODE	ACTION	PRIORITY	COST	PERFORMANCE MEASURE	RESPONSIBILITY
C1	Better data sharing and communication between community groups and council, including notification of significant activities and developments along the river corridor	Ongoing	<\$10K p.a.	Shared knowledge as basis for decision-making	Environmental Health
C2	Liaise with agencies responsible for management of the corridor upstream (including Googong Dam) and downstream	Ongoing	<\$10K p.a.	Shared knowledge as basis for decision-making	Environmental Health
C3	Investigate extension of the ACWA (Actions for Clean Water) program into the Queanbeyan River	Med	<\$10K	Extend ACWA program	Environmental Health
C4	Refer to water sharing plan regarding water extraction licenses & flows	Ongoing	<\$10K p.a.	Shared knowledge as basis for decision-making	Environmental Health
C5	Liaise with the ACT Government to implement a long-term program to remove willow infestations, to formalise walking tracks and community access and to remove build up of litter from the river in areas within its jurisdiction	Med	<\$10K p.a.	Continue rehabilitation and recreation links downstream	Environmental Health
C6	Give careful consideration to the sequence of on-ground works	Ongoing	<\$10K p.a.	Avoid damaging previous works / unnecessary cost	All
C7	Update Council's asset management/GIS database with information about infrastructure within the river corridor (e.g. bins, playgrounds, toilets, fences, signs, seats, paths, BBQs, stormwater controls, bridges, pipes)	High	<\$10K p.a	Current data available	Infrastructure
C8	Refer to the asset database and GIS maps when developing proposals for new infrastructure in the corridor	Ongoing	<\$10K p.a	Informed decision-making	All

Table 15: Education actions for community, Council staff, developers etc

CODE	ACTION	PRIORITY	COST	PERFORMANCE MEASURE	RESPONSIBILITY
E1	Provide developers and landowners with a brochure/list of suitable local provenance plant species to use in landscaping and revegetation projects (e.g. via local nurseries, Council's website, newsletters & DA process) - refer to Appendix J	High	<\$10K	Planting list available in a variety of formats	Environmental Health
E2	Develop logo for the Queanbeyan River corridor that incorporates the river's values to use in signage, promotions etc	High	<\$10K	Logo developed	Environmental Health
E3	Stormwater drain stencilling to raise community awareness about where stormwater flows to and the risk of polluting local waterways	Low	<\$10K	Drain stencilling done	Environmental Health
E4	Investigate how specific groups (e.g. schools, environmental, recreation, business) can be involved in river management (e.g. canoeists/kayakers could assist with on-river clean up; engage and educate recreational anglers) and develop a community involvement program in consultation with Waterwatch and DPI Fisheries Conservation Group	High	<\$10K	Database of contacts; community involvement program developed	Environmental Health
E5	Install/update regulatory signage, focusing on known problem areas and issues (e.g. rubbish dumping, trail bikes, discarded fishing line)	Med	\$10-50K	Signage updated	Environmental Health
E6	Upgrade High Street reserve so that it includes a fenced area for off-lead dog activity. Dogs should be on-lead in other areas along the river corridor	High	\$10-50K	Greater dog control	Infrastructure
E7	Enforce penalties re dumping rubbish and pollutants	Ongoing	<\$10K	Penalties issued	Infrastructure
E8	Continue sustainability programs to improve water use efficiency (e.g. Waterwise)	Ongoing	<\$10K p.a.	Sustainability programs continued	Infrastructure
E9	Distribute/promote existing educational material produced by the CMA and NSW DPI e.g. 'Key tips for a fish friendly farm' brochure, 'Don't dump that fish' (available online) and 'What is Gambusia?' brochure. Raise awareness about pest fish - carp and redfin	Ongoing	<\$10K p.a.	Existing educational material promoted	Environmental Health
E10	Carp fishing competition and education. Liaise with the Invasive Animals CRC at Canberra University regarding effective carp removal techniques. The Capital Regional Fishing Alliance has offered to assist with the competition and education	Low	<\$10K	Fishing competition	Environmental Health
E11	Promote demonstration sites of 'best practice' rehabilitation to highlight to the community what is being achieved and how they can be involved	Low	<\$10K	Promotion material & signs	Environmental Health

E12	Train Council staff & contractors regarding the importance of the river corridor; suitable management of playing fields regarding fertiliser and water use; requirements for protection/management of EECs and threatened species; and basic rehabilitation techniques (e.g. weed identification, plant selection)	High	\$10-50K	Staff and contractors trained	infrastructure
-----	--	------	----------	-------------------------------	----------------

Table 16: Research and monitoring actions

CODE	ACTION	PRIORITY	COST	PERFORMANCE MEASURE	RESPONSIBILITY
M1	Liaise with ACTEW regarding impacts associated with flow releases from Googong Dam, and spread of aquatic weeds (e.g. <i>Egeria densa</i>)	Ongoing	<\$10K p.a.	Shared knowledge as basis for decision-making	Environmental Health
M2	Continue current water quality monitoring (including macroinvertebrates) and make results publicly available via State of Environment Reports and Council's website	Ongoing	\$10-50K p.a.	Gauge effectiveness of rehabilitation efforts; inform community regarding health and safety of waterway	Environmental Health
M3	Seek grant funds or in-kind contribution (e.g. university research project) for comprehensive water quality monitoring project. Samples to be taken where each tributary and point source discharges to the river. Samples to be taken immediately following at least ten major rain events and tested for wide spectrum of parameters including nutrients. Results should be made publicly available	Low	\$50-100K	Inform community regarding health and safety of waterway; good basis for decision-making	Environmental Health
M4	Support community involvement in platypus & water rat monitoring, Waterwatch and Frogwatch	Ongoing	<\$10K p.a.	Gauge effectiveness of rehabilitation efforts	Environmental Health
M5	Further studies and consultation with the Aboriginal community to ensure protection of heritage sites and increase awareness of Aboriginal heritage. In particular, investigate opportunities to incorporate information about Aboriginal heritage in walking paths/tracks e.g. via signage	Med	\$10-50K	Improved protection and understanding of Aboriginal heritage	Environmental Health
M6	Monitor fish restocking	Ongoing	<\$10K p.a.	Gauge effectiveness of restocking	Environmental Health

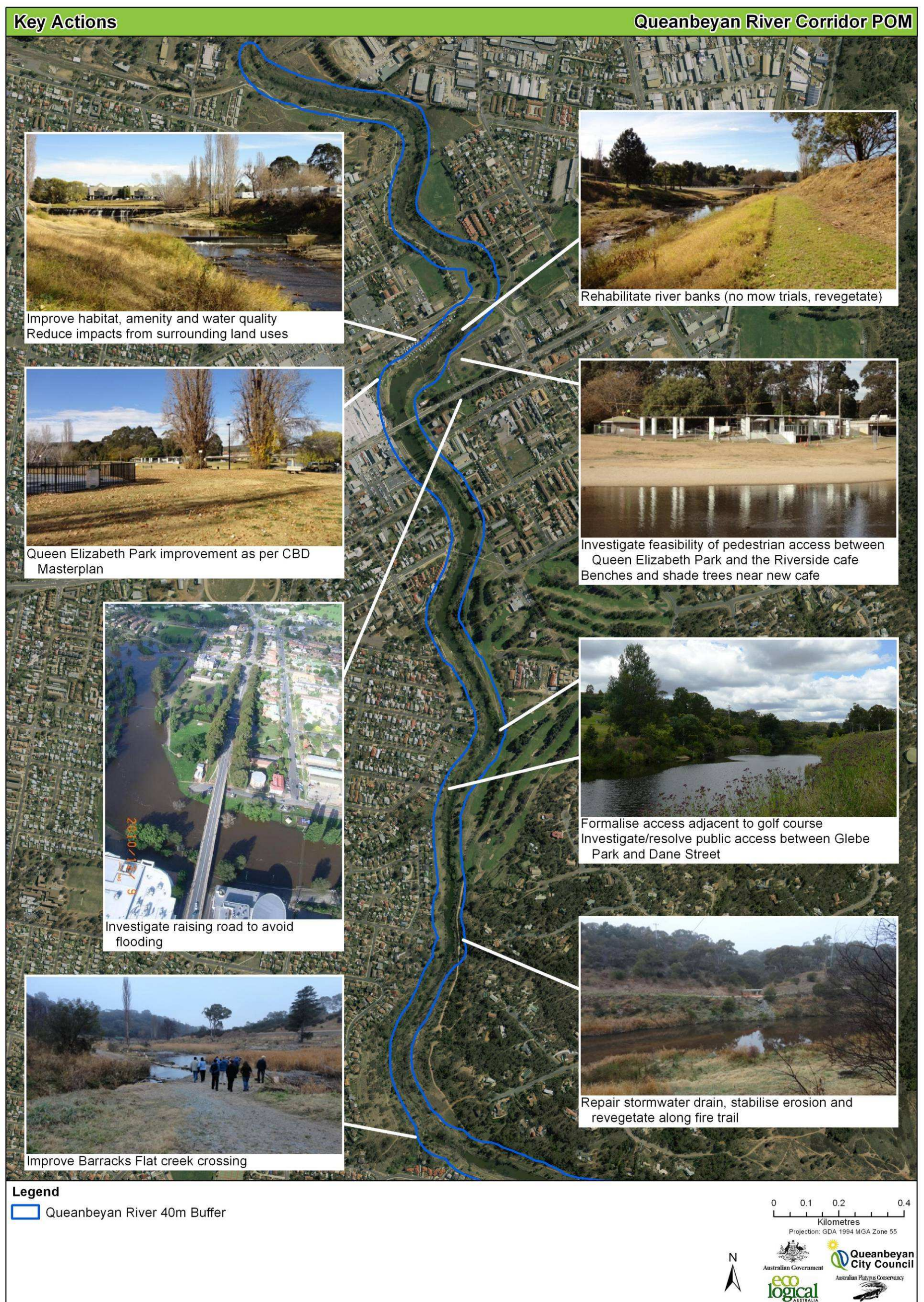


Figure 8: Key actions

5 Implementation

Rehabilitation of the river corridor will enable ecosystems and the Queanbeyan community to be more resilient to the consequences of predicted climatic changes. This strategy identifies the need for significant investment in the rehabilitation and improvement of the Queanbeyan River corridor. This can best be achieved incrementally across the entire corridor, with the strong support of the community, and with substantial allocation of funds and resources.

The following table provides guidance to assist the implementation process for the main actions.

Table 17: Implementation guide

ITEM	DESCRIPTION
Asset management	Council's asset management / GIS database should be updated with information about the types, locations and condition of infrastructure within the river corridor (e.g. bins, playgrounds, toilets, fences, signs, seats, paths, BBQs, stormwater controls, bridges, pipes). This information should be used when planning new infrastructure and rehabilitation / revegetation in the corridor. This will ensure facilities are delivered in areas where they are most needed, and can be appropriately designed, scheduled and maintained/serviced.
Communications strategy	<p>Many of the actions in this strategy aims to educate and involve the community in management of the corridor. There are a number of avenues currently available for consulting or disseminating information to the community (e.g. Council's website, government brochures, Waterwatch and Landcare activities, signage, media).</p> <p>Council's Environmental Manager is the main coordinator of community activities affecting the corridor. Council is supported in this role by the Molonglo Catchment Waterwatch Coordinator, and the Environment and Sustainability Advisory Committee. To improve coordination of communications, it is recommended that this group:</p> <ul style="list-style-type: none"> • Develops a logo for use in all communications material (including signage) • Establishes a stakeholder database which is shared and regularly updated • Develops templates for signage and other forms of communication relevant to the corridor • Coordinates community activities such as monitoring, on-ground works and recreational events (e.g. the Regatta)

Bush regeneration team - 'River Team'	<p>A team of professional bush regenerators should be established to:</p> <ul style="list-style-type: none"> • Plan and prioritise rehabilitation activities, including establishment and maintenance of vegetated buffer zones identified in the Platypus Strategy (giving consideration to the requirements for infrastructure maintenance and development) • Identify, monitor and establish no mow areas to encourage natural regeneration along the river • Control weeds (e.g. near threatened species' habitat, in areas where willows have been removed) • Remove rubbish in public areas within the corridor • Assist with track maintenance • Discourage unwanted activities e.g. trail bikes, rubbish dumping • Assist / supervise community groups undertaking rehabilitation work • Revegetate to stabilise erosion, and improve landscape amenity and habitat • Assist with seed collection • Undertake monitoring and update the NSW Atlas of Wildlife records
Access adjacent to Queanbeyan Golf Course	The concept design by dsb Landscape Architects should be open to public comment prior to detailed design and construction. Plant selection should be consistent with species in Appendix J
CBD (encompassing Queen Elizabeth Park, Ray Morton Park, Queanbeyan River Recreation Reserve, the caravan park and weirs)	The proposed study into the feasibility of a new pedestrian bridge / pontoon from Queen Elizabeth Park to the other side of the river should be combined with detailed plans to improve amenity, reduce erosion and improve habitat of the river banks by no mow zones and revegetation; reduce pollutants to the river from surrounding land uses; and upgrade facilities near the new cafe. Additional actions proposed for this area have been identified in this plan (and the CBD Masterplan), but have a lower priority
Access between Glebe Park and Dane Street	There are a number of options available to resolve public access between Glebe Park and Dane Street. The community should be further consulted further to determine the preferred route, prior to detailed design and construction (including landscaping and signage). Until the access issue is resolved, Council should erect signage at Dane St and the southern end of Glebe Park to indicate the available pedestrian route
Rehabilitation of the stormwater drain and surrounds opposite Dane Street	Bank stabilisation, stormwater infrastructure repair and revegetation are required on the river bank opposite the end of Dane Street
Barracks Flat crossing and tributary	Improvements to the creek crossing and rehabilitation of the Barracks Flat tributary should be achieved in conjunction with proposed development of adjacent land

5.1 FUNDING AND RESOURCES

Funding and in-kind contributions should be sought from a range of sources to implement this Strategy, for example:

- State and Commonwealth government environmental grants (e.g. Environmental Trust, Regional Australia, fisheries habitat action grants⁶)
- Council levies and funds
- Community volunteers
- Donations
- Sponsorship from local businesses

Responsibility for implementation of this plan rests primarily with Queanbeyan City Council. Implementation of the actions outlined in the strategy is dependent on the demands made on Council, its preferred priorities in any one financial year and the availability of resources each financial year. Possible external sources of funding should therefore be sought to assist Council in undertaking capital works associated with this strategy.

External grants are generally available annually but may vary as to the sum of capital assistance available and the criteria for preferred projects being promoted by the funding body. Grants are generally not available to contribute towards maintenance works which remain the responsibility of Council. In addition grants are only available for a limited time and are not available every year. The availability of grants can be limited to only twelve months or may be available for a set period. Financial assistance from grants is generally confined to a dollar for dollar contribution. This requires Council to contribute 50% of the costs of the project and the funding body contributing the other 50%.

The total amount and number of grant funds that are available from any one source at any one time is very limited. The availability of grant funding is also competitive between all applicant Councils. Therefore, Council cannot entirely rely on grants to commence and supplement a project. However, it should apply to any grant body for assistance where any of its projects comply with the grant criteria.

This Riparian Corridor Strategy can assist Council in the preparation of suitable grant applications. In addition, the State and Federal Governments periodically introduce new grant programs. These may address a specific social, economic or environmental issue. Council will need to monitor these as they are introduced.

The consequence of a failure to adequately maintain a valuable asset (including healthy ecosystems and public amenity) is seen in the cost to rehabilitate the asset at a later date, which is usually higher to the community. Further consequences result in a loss of public accountability in asset management as well as a reduction in asset service value. Ongoing maintenance and replacement of existing assets is preferred as a course of action where the asset has high community value and use. However if the rate of deterioration has exceeded reasonable ongoing maintenance expenditure, repair or replacement costs, the Council will need to give consideration to further action.

⁶ <http://www.dpi.nsw.gov.au/fisheries/habitat/rehabilitating/ahr-grants-program>

5.2 LEASES AND LICENSING

In accordance with s. 47B of the *Local Government Act 1993* a lease, licence or other estate cannot be granted over community land categorised as a natural area for a building or structure that is not a building or structure prescribed by the Act or Regulations. It is the intention of this strategy not to permit leasing of any natural areas but seeks the protection and conservation of these areas for future generations. As such only the issuing of licences on the community land subject to the general and specific conditions of uses set out in this strategy will be permitted.

Principles for licensing and leasing community land are tabulated below.

Requirements for leasing or licensing Crown land should be referred to the Department of Primary Industries - Crown Lands Department e.g. *Guidelines for the Creation of New Commercial Leases for Caravan Parks on Crown Land in NSW* (LPMA 2009).

Table 18: Principles for licensing and leasing community land

ISSUE	PRINCIPLE
Lease agreements	No lease agreements are to be made for community land within the corridor
Permitted Uses	No leases or licences are to be issued for the occupation or private use or crossing of those areas categorised as Natural Area. Except to construct, connect, maintain or any other works required to any essential public utility services located or to be created in the reserve or for an emergency services.
Licences Permitted Uses	Licences aimed at education or scientific purposes will be allowed if the use is integral to the learning experience and no other alternative is available. Licences will only be allowed if the activity will result in no damage to any flora, fauna or any other natural aspect of the community land and each application is to be decided on its own merit at the discretion of relevant Council staff.
Private Access	<p>No private access is to be authorised within the Natural Areas, to provide protection to the natural values.</p> <p>Access may be permitted where Council determines that a hazard on private property poses a direct threat to public health, safety or private property.</p> <p>In accordance with the provisions of the respective legislation access will be permitted to construct, connect, maintain or any other works required to any essential public utility services located or to be created or emergency services.</p> <p>Where access is approved to an adjoining private property owner access will be conditional and subject to an appropriate terms and conditions of the permit and the payment of all fees and charges as imposed by Council in accordance with its operational plan.</p>
Hours of Use	Hours of use of the community land will be subject to the outcomes of any negotiations between Council and the licensee and objectives of the land category.

Licence Terms	<p>Agreed negotiated period between Council and the licensee, generally not exceeding 1 year, with long term projects not exceeding 5 years, and to be reviewed and renewed six monthly.</p> <p>Seasonal licences or permits should be offered where applicable.</p> <p>Daily, weekly or monthly permits authorised to be offered at Council's discretion.</p> <p>It is mandatory for all licensees to provide Council with accurate usage and participation data and any other data requested in writing by Council before the issuing of any licence.</p>
Income	Any licensing fees and charges are to be expended by Council at its discretion for the benefit of the community.
Damage Deposit	A damage deposit may be requested before a licence is granted if the activity is or is likely to cause damage to any asset, either natural or man-made. The required deposit amount will be determined by relevant Council staff and will consider both the value of the asset and the cost of remediation of the asset in the event of damage.
Reporting	All income created through licensing will be reported annually to Council auditors.
Insurance	<p>Licensees must provide Council with copies of their Certificates of Currency for their Public Risk Liability Insurance that must be to the sum as stipulated in their licence agreements and as set out by Council's executive.</p> <p>Where a licensee has public risk liability insurance protection by their affiliation with an Association then they are required to provide proof of cover by way of a letter from their Governing Association that they are included in the Association's current policy.</p>

5.3 APPROVALS

On-ground works proposed within reserves may not require development consent if they fall within the framework of exempt development under the State Environmental Planning Policy (Infrastructure) 2007 (the SEPP). In summary, exempt development must be carried out by or on behalf of a public authority (such as the Council) and be of minimal environmental impact. Examples of exempt development listed under Schedule 1 of the SEPP include maintenance of existing trails and installation of certain types of directional or information signs.

Development consent in accordance with the *Environmental Planning and Assessment Act 1979* may be required for more substantial works such as constructing new paths and bridges.

A Section 132C licence from the OEH will be needed to conduct environmental management works such as weed control and revegetation in areas where an endangered ecological community is present.

A Section 200 permit under Part 7 *Fisheries Management Act 1994* (FM Act) may be required to dredge, modify water flows or reclaim. Such activities may be required for environmental rehabilitation purposes.

A Section 216 permit under the FM Act may be required to release or stock fish into natural waterways.

5.4 MONITORING AND ADAPTIVE MANAGEMENT

Monitoring and adaptive management are required to ensure the management objectives listed in **Section 4.2** are being achieved, or at least worked towards. If monitoring results indicate that activities are causing environmental conditions to deteriorate, additional management measures may need to be implemented (e.g. education, enforcement, soil erosion controls, and weed and rubbish removal). If conditions deteriorate further, consider restricting access to these areas temporarily or permanently.

Results of monitoring will be essential to inform adaptive management practices. Environmental managers often deal with considerable uncertainty and complexity about how ecosystems and the physical environment interact. Adaptive management is a widely accepted approach to natural resource management that involves learning from implementation. By following the adaptive management cycle, practitioners ensure that learning is focussed on management needs and that new knowledge feeds back to inform future management choices.

The effectiveness of each action should be reviewed against the performance measures in **Tables 9-16** in **Section 4.2**. The timeframes for performance review will depend on the time required for implementation of each action. This is particularly important where action is staged for implementation, because there is an opportunity to review techniques etc prior to commencement of each stage. The whole strategy should be reviewed two years, six years and ten years after implementation starts.

People (including students) involved in monitoring or research that could potentially impact a threatened species, population or ecological community or their habitats (*Threatened Species Conservation Act 1995*), or any protected species listed under the *National Parks and Wildlife Act 1974*, need to hold a current Section 132C Scientific Licence from the OEH. People seeking to trap, capture or collect native fauna are also required to obtain an Ethics Licence from NSW Industry and Investment.

References

ACT Government 2006. *Environmental Flow Guidelines*. Environment ACT, Canberra.

ACT Government 2011. *Draft 2011 Environmental Flow Guidelines*. Environment and Sustainable Development, ACT.

Armes, J 1997. *Queanbeyan River Corridor Study: Heritage sites*. Prepared for NECS, John Armes & Ass. Yass.

Barrer, P. 1993. *Bushlands, Grasslands and the Ecological Resources of the City of Queanbeyan NSW*. Report to the Trees of Queanbeyan Committee, the Queanbeyan Branch of the Monaro Conservation Society, the Queanbeyan City Council and the Save the Bush Grants Scheme, Holt, Canberra.

Barrer, P. 1997. *The Flora of South-East Yarrowlumlá – A Preliminary Assessment*. Stoney Creek Landcare Group, Queanbeyan.

Bates, B.C., Charles, S.P., Chiew, F., Harle, K., Howden, M., Kirby, M., Peel, M., Suppiah, R., Siriwardena, L., Viney, N.R. and Whetton, P.H. 2003. *Climate change projections and the effects on water yield and water demand for the Australian Capital Territory*. Consultancy for ACT Electricity and Water.

Boulton 2003. 'Parallels and contrasts: The effect of drought on stream macroinvertebrates assemblages.' *Freshwater biol.* 48:1173-1185.

Bushfire and Environmental Services (BES) 2008. *Biodiversity Study Findings Report – Queanbeyan Local Government Area*. Prepared for Queanbeyan City Council.

Connell Wagner 1999. *Queanbeyan River Corridor Plan of Management*. Prepared for Queanbeyan City Council.

CSIRO 2006. *Climate Change in the Murrumbidgee Catchment*. Prepared for the NSW Government.

DLWC 1997. *Water reform - The need for Change*. NSW Government Press, Sydney.

Dept Sustainability, Environment, Water, Population and Communities 2011. *Australian heritage Database*, www.environment.gov.au accessed 18/7/11.

Eco Logical Australia 2010. *Review of Biological Monitoring Data - Lower Molonglo Water Quality Control Centre*.

Ecwise Environmental Pty Ltd 2005. *Sediment removal by environmental flow release. Cotter River between Bendora reservoir and Cotter reservoir; Bracks Hole, Swimming Hole, Spur Hole. A report to ACTEW*, March 2005, Ecwise Environmental Pty Ltd, Canberra.

Fairfull, S. and Witheridge, G. 2003. *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*. NSW Fisheries, Cronulla, 16 pp.

Fallding, M. 2002. *A Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands*. Natural Heritage Trust, NSW National Parks and Wildlife Service and Land & Environment Planning.

Heritage NSW 2011: Heritage Database search www.heritage.nsw.gov.au accessed 18/7/2011.

Industry and Investment NSW 2011. *Freshwater Pest Fish in New South Wales*. Factsheet.

Industry and Investment NSW 2010. *NSW Control Plan for the Noxious Fish Carp*.

Industry and Investment NSW 2009. *Ten Top Tips for a Fish Friendly Council*.

Keightley, E. 2009. *Frogwatch Oct 2009: Act region community frogwatch census report*. Ginninderra Catchment Group, Canberra.

Land and Water Resources Research and Development Corporation 2000. *Managing Snags and Large Woody Debris*. RipRap Edition 16.

Lang, S. 2000. *Queanbeyan River Corridor Survey – Willow Removal Program*. Prepared for Queanbeyan City Council.

Lintermans, M., Jekabsons, M. & Morris, B. 2001. *A Survey of Fish in the Lower Queanbeyan River*. Prepared for Queanbeyan City Council.

Lintermans, M. & Jekabsons, M. 2004. *A Survey of Fish in the Lower Queanbeyan River*. Prepared for Queanbeyan City Council.

Murrumbidgee Catchment Management Authority undated. *Urban Salinity Management Plan*. Prepared for Queanbeyan City Council.

Murray-Darling Basin Ministerial Council 2003. *Native Fish Strategy for the Murray-Darling Basin 2003-2013*.

National Environmental Consulting Services (NECS) 1997. *Queanbeyan River Corridor Study*.

Norris, R.H. (1996) Predicting water quality using reference conditions and associated communities. Paper presented at Conference of North American Benthological Society, Kalispell, Montana.

Norris, R., Chester, H., Thoms, M., 2004. *Ecological sustainability of modified environmental flows in the Cotter River during drought condition January 2003-April 2004: Final Report August 2004*, Cooperative Research Centre for Freshwater Ecology, University of Canberra, Canberra.

NSW Department of Primary Industries 2006. *Reducing the Impact of Weirs on Aquatic Habitat – New South Wales Detailed Weir Review – Murrumbidgee Region*. Report to the Murrumbidgee Catchment Management Authority and the New South Wales Environmental Trust.

NSW Rural Fire Service 2003. *Bush Fire Environmental Assessment Code for Asset Protection and Strategic Fire Advantage Zones*. NSW Rural Fire Service.

NSW Rural Fire Service and Planning NSW 2001. *Planning for Bushfire Protection: a guide for Councils, planners, fire authorities, developers and home owners*. Planning NSW.

Office of the Commissioner for Sustainability and the Environment 2009. *Regional State of the Environment Report 2004-2009 Queanbeyan/ACT region*.

Osbourne, W.S., Littlejohn, M.J., Thomson, S.A. 1996. 'Former distribution and apparent disappearance of the *Litoria aurea* complex from the Southern Tablelands of NSW and the ACT'. *Australian Zoologist* 30(2):190-198.

Place Design Group with Leyshon Consulting, ARUP and Elton Consulting 2009. *Queanbeyan CBD Master Plan*. Prepared for Queanbeyan City Council.

Queanbeyan City Council 2003. *Management of Aquatic Plants on the Queanbeyan River Weir Pool (Management Unit 2a)*.

Queanbeyan City Council 2010. *Plan of Management Natural Areas Amendment No.3*.

Queanbeyan City Council 2000. *Water Quality Program for the Queanbeyan River*.

Rowell, A. & Crawford, I. 1997. *Queanbeyan River Corridor Study - Flora, Fauna and Environmental Degradation*. Unpublished report to National Environmental Consulting Services.

Skinner, S. 2010. Molonglo Catchment Health indicator program report Jan-July 2010, *Waterwatch* Molonglo Catchment, Canberra.

Simpson, J. 1995. *The effect of subsampling method on the efficiency, accuracy and precision of a predictive model for the assessment of aquatic ecosystem health*. Honours Thesis University of Canberra.

Sutton, P.; Dovers, S.; Guillaume, J. & Hutchinson, M. 2008. *The Integrated Assessment of Climate Change Impacts on Urban Settlements (IACCIUS) Project – Stormwater, impervious surfaces and climate change in Queanbeyan*. The Fenner School of Environment and Society, The Australian National University. Prepared for the Australian Government Department of Climate Change.

Yarrowlumla/Queanbeyan Bush Fire Management Committee 2002. *Bush Fire Risk Management Plan*. Yarrowlumla Shire Council and Queanbeyan City Council.

Appendix A: Lands within Queanbeyan River Corridor

LOT	DEPOSITED PLAN	ADDRESS	OWNERSHIP	CURRENT LAND ZONE	DRAFT QLEP 2012 ZONE
7339 7340	1166314	51 Wickerslack Lane, Googong	Crown Land	1 (a) 7 (a)	E2
76	42304	100 Wickerslack Lane, Googong	Crown Land	1 (a)	E3 W1
1	218721	135 Wickerslack Lane, Googong	Private	1 (d)	E4
2, 3	218721	139 Wickerslack Lane, Googong	Private	1 (d)	E4
4	218721	143 Wickerslack Lane, Googong	Private	1 (d)	E4
5	218721	145 Wickerslack Lane, Googong	Private	1 (d)	E4
6, 7	218721	151 Wickerslack Lane, Googong	Private	1 (d)	E4
8	218721	155 Wickerslack Lane, Googong	Private	1 (d)	E4
9	218721	161 Wickerslack Lane, Googong	Private	1 (d)	E4
10 - 12	218721	171 Wickerslack Lane Googong	Private	1 (d)	E4
13, 15	218721	173 Wickerslack Lane, Googong	Private	1 (d)	E4
14	218721	183 Wickerslack Lane Googong	Private	1 (d)	E4
34, 38	226218	187 Wickerslack Lane, Googong	Community Land	1 (d)	E4
32 102 104 111, 112 92 7 2	754875 375866	229 Wickerslack Lane, Googong	Private	7 (e)	E2
1	711905	30 Lonergan Drive, Greenleigh	Private	1 (a) Rural	E2, E4, RE2, DM
51	754907	39 Lonergan Drive, Greenleigh	Private	1 (a) Rural	E2, E3
113 115, 116 1	754875 375866	100 Lonergan Drive, Greenleigh	Private	7 (e)	E2
51	835313	113 Barracks Flat Drive, Karabar	Community Land	6 (a)	RE1
39	1007139	133 Barracks Flat Place, Karabar	Community Land	6 (b) 2 (d)	RE1
2	552380	47 Pindari Crescent, Karabar	Community Land	7 (a)	E2
6	837155	12 River Drive, Karabar	Private	2 (d) 6 (b)	R3 RE1

112	705742	14A Granville Close, Greenleigh	Community Land	7 (a)	E2
20	837155	18B River Drive, Karabar	Community Land	6 (a)	RE1
23	869351				
105	707719				
243	803621				
20	818066				
58, 59	221948	28 Dane Street, Queanbeyan	Community Land	7 (a)	E2
24	239425	29 Dane Street, Queanbeyan	Community Land	7 (a)	E2
17	223652	1 Dodsworth Street, Queanbeyan	Community Land	6 (a)	RE1
20	538743				
Crown Reserve	R83835	Golf Course 1 Brown Street, Queanbeyan	Crown Land	6 (a)	RE1
Pt Lot 1	758862	Glebe Park	Community Land	6 (a)	RE1
Sec 20	252019	11 Thorpe Avenue, Queanbeyan			
1, 2	14068	15 Thorpe Avenue, Queanbeyan			
48	14068	15 Thorpe Avenue, Queanbeyan	Community Land	6 (a)	RE1
127	32640	17 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
128	32640	19 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
130	32640	23 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
131	32640	25 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
132,	32640	27-31 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
133	825934				
1	825934	33 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
2	825934	33 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
D	159255	35 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
E	159255	37 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
A	157774	39 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
1	805759	41 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
2	805759	43 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
3, 4	541939	45 Thorpe Avenue, Queanbeyan	Private	2 (a)	R2
2	710056	51A Thorpe Avenue, Queanbeyan	Community Land	2(a)	RE1
129	32640	49 Hayes Street, Queanbeyan	Private	2 (a)	R2
3, 4	792307	61 Isabella Street, Queanbeyan	Community Land	6 (a)	RE1
Crown Reserve	R46437	51 Trinculo Place, Queanbeyan	Crown Land	6 (a)	RE1
Pt Lot 6	1099164	Ray Morton Park 6 Trinculo Place, Queanbeyan	Community Land	6 (a)	RE1
1	597143				
2	749033				
Pt Lot 7322	1165688	Morisset Street Round about 13 Waniassa Street, Queanbeyan	Community Land	6 (a)	RE1
9	1129959	9 Waniassa Street, Queanbeyan	Community Land	6 (a)	RE1 W1
1	593382				
1	749033				
10, 11	1129959				

Pt Lot 7322	1165688 Crown Reserve 85693	Queen Elizabeth Park 41 Morisset Street, Queanbeyan	Crown Land	6 (a)	RE1
125	1000250 Crown Reserve R85693	Riverside Caravan Park 41A Morisset Street, Queanbeyan	Crown Land	6 (a)	RE1
7319 7320 7323 7324 7325	1165688	100 Morisset Street, Queanbeyan	Crown Land	6 (a)	RE1
Crown Reserve	R88284	38A Carinya Street, Queanbeyan	Crown Land	6 (a)	RE1
6 Sec 6	978284	2A Ford Street, Queanbeyan	Community Land	6 (a)	RE1 W1
3	1021603	2-8 Ford Street, Queanbeyan	Community Land	6 (a)	RE1 W1
Crown Reserve	R89205	Blundell Park 20 Ford Street, Queanbeyan	Crown Land	6 (a)	RE1
116	821709	63 Carinya Street, Queanbeyan Including access road	Crown Land	6 (a)	RE1
7341	1166442	10 Jinaroo Street, Queanbeyan	Crown Land	6 (a)	RE1
1	705520	31 Jinaroo Street, Queanbeyan	Community Land	6 (a)	RE1
Crown Reserve	R95617	Riverside Cemetery 40 Erin Street, Queanbeyan	Crown Land	6 (a) 5 (a)	RE1 SP1

Parcels of land identified as being part of the river corridor are tabulated below and illustrated in **Figures 2 to 4.**

Appendix B: Platypus Awareness and Conservation Strategy

Prepared by M. Serena and G.A. Williams – Australian Platypus Conservancy

Draft 17 October 2011

This appendix is also available as a stand-alone report.

ACKNOWLEDGEMENTS

This report has been commissioned by Queanbeyan City Council as part of its ongoing commitment to conserving biodiversity in the Queanbeyan area. We are particularly indebted to Natasha Abbott (Manager Environment and Health) for her assistance in implementing this project.

We also thank Luke Johnston (ACT Environment and Recreation) for providing platypus by-catch records from fish surveys and other input about the distribution of platypus in the Capital Region, and Tanya Rukosky Noakes (Upper Murrumbidgee Waterwatch) for supporting development of the *Platypus Count* program in Queanbeyan and assisting with community consultation activities in the course of formulating this PACS.

Finally, thanks are due to Beth Medway of Eco Logical Australia for all her hard work in integrating this PACS into the overall Plan of Management for the Queanbeyan River.

G A Williams and M Serena

Australian Platypus Conservancy

PO Box 22

Wiseleigh VIC 3885

Tel: 03 5157 5568

Email: platypus.apc@westnet.com.au

Website: www.platypus.asn.au

Australian Platypus Conservancy



EXECUTIVE SUMMARY

Queanbeyan City Council (QCC) has a crucial role to play in conserving platypus in the Queanbeyan River and the wider Molonglo River upper catchment area.

The platypus population in the Queanbeyan River is not currently considered to be threatened. Nevertheless, the total number of animals estimated to be resident in this waterway – in the order of 60 individuals - is small in an absolute sense. Future urban growth and climate change are likely to have considerable impact on the river in the near to medium term future. Consequently, the survival of platypus in the Queanbeyan River will depend on positive action to protect and enhance conditions which favour the species. In addition, action to protect platypus within the QCC area will have consequences well beyond the city's geographic boundaries.

This document outlines a Platypus Awareness and Conservation Strategy for QCC. Three major elements are contained in the PACS:

1. Making provision for platypus in works protocols and management of public land

A range of recommendations are made to ensure that the needs of platypus are routinely incorporated into the planning and day-to-day management of reserves and public lands which have frontage on natural water bodies. These recommendations are also designed to provide a “blueprint” for implementing riparian management action.

2. Making provision for platypus in planning procedures

The key recommendation is that all relevant Environmental Significance Overlays (ESO) in QCC should include specific consideration of platypus conservation needs along the Queanbeyan River and the lower reaches of its major tributaries.

In the case of proposed major developments, it is further recommended that an Environmental Impact Statement (EIS) addressing potential platypus-related impacts be required at the planning application stage.

3. Developing the role of platypus as a biodiversity “flagship” in community education and investigating ecotourism opportunities

Various measures are suggested for improving community awareness of platypus conservation needs as well as utilising the species as an ambassador for biodiversity conservation in QCC.

A key recommendation is to establish a Platypus Conservation Zone close to the CBD. It is also recommended that the feasibility of developing platypus-spotting ecotourism opportunities in Queanbeyan be investigated.

INTRODUCTION

The platypus is one of the world's most remarkable animals. It is an important biological component of permanent freshwater systems in southeastern Australia and a powerful and popular conservation icon.

Unfortunately, platypus numbers have declined in many urban and rural waterways. Climate change is predicted to further erode the security of many populations. Consequently, developing local conservation plans for the platypus should be a feature of good government throughout the species' range.

Queanbeyan City Council (QCC) has a crucial role to play in conserving platypus in the Queanbeyan River and the wider upper Molonglo catchment area.

Overview of Platypus Awareness and Conservation Strategy

This document outlines a Platypus Awareness and Conservation Strategy (PACS) to be incorporated as part of the overall Plan of Management (POM) for the Queanbeyan River. Most of the recommendations contained in the PACS will have much broader implications for protecting biodiversity given that conditions that are right for the platypus - a species located at the top of the freshwater food chain – by definition will favour many other aquatic plants and animals.

In addition, this document has been designed to contribute to “best practice” management of public land by identifying opportunities for improving the care and rehabilitation of riparian areas under QCC control and outlining recommended management protocols in relation to platypus and their habitat.

The PACS has also been designed to highlight ways in which municipal planning can assist platypus conservation. This will help QCC meet its obligations to conserve biodiversity values and avoid the acrimonious debates that can develop if there has been a perceived failure by Council to adequately protect platypus and their habitat.

Last but certainly not least, the document outlines opportunities for platypus-based community environmental education, including potential for attracting additional visitors to Queanbeyan to see the animals in their natural habitat.

Structure of PACS

The PACS is presented in distinct sections, some of which are designed for potential use by relevant departments within QCC, as follows:

- Background information
- Platypus status and distribution in Queanbeyan
- Threats to platypus survival in Queanbeyan
- Platypus Conservation Recommendations
- Works protocols for management of public land
- Planning protocols to protect platypus habitat
- Community education and ecotourism development
- Action Plan

Definitions

In this document, the term “Queanbeyan River” will be used to define the section of the river from the wall of Googong Dam to the confluence with the Molonglo River. (The river upstream of Googong Dam will be referred to as the Upper Queanbeyan catchment).

It is recognised that the Queanbeyan River, as so defined, includes short reaches at its upper and lower ends that are not within the boundaries of Queanbeyan City Council. However, all comments and recommendations in this PACS will apply to the full length of the river, unless otherwise stated. Accordingly, QCC should take steps to involve all management authorities responsible for the non-QCC sections in the implementation of the PACS.

In addition to platypus, the Australian water-rat (*Hydromys chrysogaster*) occurs in the Queanbeyan River (see section 2.6). This attractive native rodent is equally deserving of community awareness and conservation efforts. Recommendations in this report concerning platypus should be regarded as also applying to water-rats.

DISTRIBUTION AND STATUS OF THE PLATYPUS IN QUEANBEYAN

Methodology

Live-trapping surveys have traditionally been the basis for assessing platypus status and distribution along waterways. Such work is time-consuming, relies on specialised equipment and can only be legally undertaken after official permits are issued. In addition, existing trapping methods are not particularly effective at assessing platypus numbers when water is deeper than about one metre and/or numerous surveys are carried out in close succession (thereby promoting trap shyness).

No live-trapping surveys for platypus have ever been conducted along the Queanbeyan River and it would not be cost-effective to assess current platypus status and distribution using trapping techniques.

Fortunately, other information is available on which to base a reasonable assessment.

The main categories of information are as follows:

- Platypus by-catch records from fish surveys.
- Findings from a community-based visual monitoring program (*Platypus Count*) and other observational records.
- Evaluation of platypus-related habitat values along the length of the river.

Information from fish surveys

Platypus were recorded as by-catch during fish surveys conducted along the Queanbeyan and Molonglo Rivers from 1973-2006 (Dept. Environment and Recreation ACT, unpub. data).

Although fish and platypus trapping surveys both rely on nets, their outcomes are not necessarily equivalent. In the case of rectangular mesh (or “gill”) nets, fish are most effectively sampled by weighting the bottom margin of nets with lead weights; unfortunately, this often causes entangled platypus to drown (Grant and Carrick 1974). In the case of fyke (or eel) nets, available evidence indicates that fyke nets as deployed in fish surveys (with single wings stretched parallel to the banks) capture only about 15-20% as many platypus as when fyke nets are set specifically to catch this species (with two wings stretched across the entire width of the channel and potential gaps between the net and stream bottom blocked using rocks) (APC unpub. data).

Despite these limitations, by-catch records from fish surveys can contribute useful indicative information about the platypus's distribution and status. In particular, the percentage of females in a platypus population is expected to reflect local habitat productivity, with more productive platypus habitats supporting a greater percentage of females.

This reflects the fact that breeding females are solely responsible for raising juveniles, and consequently require access to richer and more reliable food resources (mainly in the form of bottom-dwelling aquatic macro-invertebrates) than do males. In absolute terms, an adult female raising twins in captivity has been found to consume about three times more food as compared to when she was not lactating (Holland and Jackson 2002). By comparison, males can more readily make use of relatively poor or suboptimal habitats through much of the year, as their reproductive success only depends on finding and mating successfully with receptive females during the spring breeding season.

From 1973-2006, 168 incidental platypus captures were recorded during fish surveys in the Queanbeyan and Molonglo catchments, including 20 in the Queanbeyan River downstream of Googong Dam, 45 in Googong Dam, 64 in the catchment area upstream of Googong Dam and 39 in the Molonglo River upstream of Lake Burley Griffin (Table 1). Interestingly, the Queanbeyan River downstream of Googong Dam was found to support a higher percentage of females than the Molonglo River and Googong Dam itself (where most of the water body would be too deep for productive platypus foraging). However, it supported fewer females as compared to the upper Queanbeyan catchment upstream of Googong Dam, where habitat conditions are relatively pristine.

Table 1. Distribution of platypus by-catch during fish-surveys in the Queanbeyan and Molonglo catchments from 1973-2006. % females was calculated as a percentage of total captures, excluding animals of unknown gender.

<i>Water body</i>	<i>Males</i>	<i>Females</i>	<i>Unknown</i>	<i>Total</i>	<i>% Females</i>
Molonglo River	26	12	1	39	32%
Queanbeyan River	10	8	2	20	44%
Googong Dam	31	14	0	45	31%
Upper Queanbeyan catchment	30	30	4	64	50%
Total	97	64	7	168	40%

More detailed information on the distribution of platypus in the Queanbeyan downstream of Googong Dam can be gleaned from the results of fish surveys conducted from 1998-2004 (Lintermans *et al.* 2001; Lintermans and Jakobsons 2004). This work sampled three parts of the river: the Oaks Estate (c. 0.75 km upstream of the Molonglo confluence), Dane Street (c. 0.75 km upstream of the suspension bridge) and Talpa (c. 2 km downstream of Googong Dam). Each survey utilised 10 single-wing fyke nets and 2 rectangular mesh nets per area.

This work resulted in 14 platypus being captured (Table 2). The greatest number of captures and the highest percentage of females were both recorded at Talpa, upstream of the urban area. By comparison, approximately half as many platypus captures were recorded (and half as many females encountered) at Dane Street. No platypus were recorded at Oaks Estate, suggesting that the species occurs at best at low density at the downstream end of the river.

Table 2. Platypus by-catch during fish surveys along the Queanbeyan River downstream of Googong Dam from 1998-2004. % females was calculated as a percentage of total captures, excluding animals of unknown gender.

Location	Males	Females	Unknown	Total	% Females
Oaks Estate	0	0	0	0	----
Dane Street	2	1	1	4	33%
Talpa	4	6	0	10	60%
Total	6	7	1	14	54%

Visual monitoring

A community-based visual monitoring program for platypus and water-rats (*Platypus Count*) has been carried out as a joint effort by the Australian Platypus Conservancy and Upper Murrumbidgee Water Watch starting in early 2009. The program is providing data which enables the activity of both species to be tracked on a monthly basis in the area stretching from approximately Dane Street downstream to the weir (Fig. 1).

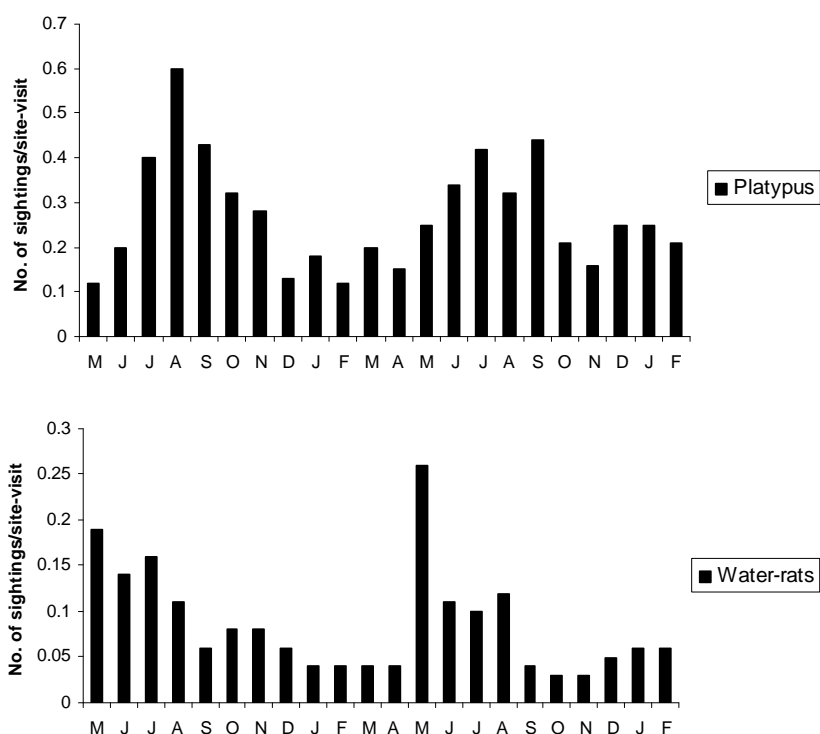


Fig. 1. Mean (or average) number of platypus and water-rat sightings recorded per site-visit along the Queanbeyan River at Queanbeyan township from May 2009 to February 2011.

Activity in both species has been found to vary seasonally, with platypus activity generally peaking in winter/early spring and water-rat activity peaking in late autumn/winter. In both cases, this is likely to reflect the species' respective annual life history cycles along with the need to forage longer hours in winter in response to cold air and water temperatures. Although visual monitoring does not allow the

absolute size of a population to be estimated, it does provide a powerful tool for tracking how well a given population is doing over time. For example, data from the Queanbeyan program made it possible to determine how well local platypus and water-rat populations coped with the one-in-twenty-year flooding that occurred along the Queanbeyan River in December 2010.

Platypus population assessment based on habitat attributes

On 16-17 March 2011, APC biologists walked the length of the Queanbeyan River from the Molonglo River confluence upstream to White Rocks, and from Googong Dam downstream for a distance of c. 1.0 kilometre, in order to develop an estimate of platypus numbers along three consecutive sections of the Queanbeyan River. These sections broadly correspond to those sampled in the 1998-2004 fish surveys (see section 2.2):

- 1) Lower – Molonglo River confluence upstream to main weir wall
- 2) Middle (Queanbeyan township) – main weir wall upstream to White Rocks
- 3) Upper – White Rocks upstream to Googong Dam

The quality of platypus habitat in each section was assessed in terms of key platypus-related attributes and other relevant environmental information (see appendix C for details).

Based on the habitat findings, and knowledge of platypus population densities in a broad range of habitat types (derived from APC live-trapping surveys conducted in 27 different river catchments from 1995-2010), estimated densities of resident adults and subadults in the three sections are described below (Table 3). The total size of the resident platypus population in the area stretching from the Molonglo River confluence upstream to the Googong Dam wall is estimated to be in the order of 43-79 animals.

Table 3. Estimated platypus population density (adults and subadults) in three sections of the Queanbeyan River (March 2011).

<i>Section</i>	<i>Length (km)</i>	<i>Estimated no. of platypus/km</i>	<i>Estimated total no. of platypus</i>
Lower	3	1-2	3-6
Middle (Queanbeyan township)	5	2-5	10-25
Upper	6	5-8	30-48
Estimated total population			43-79

Status of the platypus in tributaries of the Queanbeyan River and other waterways in the QCC area

There appear to be no confirmed reports of platypus being seen in any of the major (named) tributaries of the Queanbeyan River, including Buttles Creek, Barracks Creek and Jumping (or Valley) Creek.

APC biologists inspected the lower reaches of these creeks in March 2011 and concluded that platypus are unlikely to occupy any of them on a permanent basis because flow is unreliable and habitat conditions are generally suboptimal. However, it is possible that a few platypus (especially

subadult/non-breeding individuals) may occasionally use these creeks for foraging when flows are adequate.

As part of the long-term plan for expanding the area of usable habitat for platypus in the Queanbeyan River, it would be sensible to incorporate the lower reaches of these tributaries into the scope of the PACS.

In the case of Jerrabomberra Creek, all known platypus records (four animals caught as by-catch during fish surveys in the mid-1970s and two sightings reports in 2003 and 2009 respectively) are associated with the Wetlands Nature Reserve in the ACT, close to the Molonglo River confluence. There is therefore no evidence that any platypus currently occupies the QCC section of Jerrabomberra Creek. Nevertheless, as part of the long-term protection strategy for this species in the upper Molonglo catchment, it would again be sensible to apply all PACS recommendations to Jerrabomberra Creek, including developing a collaborative management plan with ACT authorities.

Status and distribution of Australian water-rats in the Queanbeyan River

In addition to platypus, the Australian water-rat or rakali (*Hydromys chrysogaster*) appears to be well established along the Queanbeyan River.

Formal records for this species are relatively scarce (e.g. only three records for the QCC area are included in the Atlas of NSW Wildlife). This presumably reflects the relatively low level of public awareness of this species, along with the fact that water-rats are rarely recorded as by-catch in fish surveys because of their ability to chew their way out of nets.

However, results of the *Platypus Count* monitoring program in Queanbeyan have confirmed that this species is widely observed in the township and appears to be reasonably abundant (see 2.3).

Platypus and water-rats co-exist along many waterways in eastern Australia, but Queanbeyan appears to provide an unusually good location to observe both species with almost equal facility. This situation provides a significant market advantage for ecotourism development (see 6.3).

The ecological and conservation requirements of the Australian water-rat are relatively poorly understood, reflecting the fact that the species is difficult to study in the wild. However, as top predators in aquatic systems, platypus and water-rats probably share many of the same general needs. Accordingly, most of the management recommendations in this PACS will be equally applicable to water-rats.

The Australian water-rat is an attractive native rodent that is best thought of as “Australia’s answer to the otter” to avoid possible negative connotations that it is a “rat”. Greater community understanding of this species is highly desirable. Recommendations in this report concerning steps to improve platypus awareness should therefore be regarded as applying equally to water-rats.



THREATS TO PLATYPUS SURVIVAL

Loss or degradation of riparian vegetation

Riparian vegetation is essential to platypus survival in many ways:

- It contributes to the quality of platypus burrow habitat.
- It provides protective cover for platypus when they are active in the water, thereby reducing mortality due to predation.
- It contributes to the development of stable and productive populations of aquatic macro-invertebrates on which the platypus feeds.

Several different studies have reported a significant positive relationship between the distribution of platypus numbers or feeding activity and the number of medium-to-large native trees growing within 20 metres of the water (Holwell *et al.* 1998; Serena *et al.* 2000, 2001a, 2001b; Worley and Serena 2000). Similarly, the presence of shrubs and ground cover plants next to or overhanging the water has been linked in a positive manner both to platypus feeding activity (Ellem *et al.* 1998; Serena *et al.* 1998a; Worley and Serena 2000) and the animals' use of burrows (Holwell *et al.* 1998; Serena *et al.* 1998b).

In an urban or rural fringe context, protecting (or enhancing) a substantial corridor of indigenous vegetation along both banks of a creek or river will help to screen out loud noise and artificial light, trap litter and pollutants arising in adjoining developed areas, reduce trampling and bank erosion, restrict access by foxes and uncontrolled pets, and generally promote the development of a more diverse and productive freshwater ecosystem.

Studies of platypus foraging behaviour have also found that this species tends to avoid feeding in areas of stream dominated by willows (Serena *et al.* 1998a, 2000, 2001a, 2001b). The negative relationship between platypus activity and willows does not simply reflect the fact that willows are a non-indigenous species, as (for example) a negative relationship has not been recorded to date between platypus foraging behaviour and the occurrence of riparian poplars (Serena *et al.* 2000, 2001b). Platypus are likely to find it difficult to extract macro-invertebrates from the fibrous mats of willow roots that characteristically invade shallow water bodies (Serena *et al.* 2001b), and aquatic insects may be less abundant in pools that have been invaded by willows due to reduced dissolved oxygen levels in summer and autumn (Read and Barmuta 1999; Serena *et al.* 2000, 2001a).

Studies have shown that removing willows from creek and river banks does not disrupt platypus populations over the short term, provided methods are used which do not affect the structural integrity of banks – e.g. by poisoning willows at or before the time they are cut down, leaving their stumps and roots to decay, and replanting the bank with native vegetation as soon as possible (Serena and Williams 1997).

Platypus habitat is predicted to be most productive where plant species which have evolved in the local area are established on creek or river banks. Nevertheless, a staged (as opposed to wholesale) removal program for weeds (including willows) may in some cases be the best strategy for also achieving the following platypus habitat management objectives:

- Minimise the potential for banks eroding.
- Maintain shade over the water (to reduce fluctuations in water temperature that can deleteriously affect macro-invertebrates and hence the platypus food supply).
- Provide adequate protective cover from predators and direct human disturbance (both for platypus and their burrows).

Much of the Queanbeyan River downstream of Googong Dam, especially downstream of White Rocks, has experienced loss or degradation of riparian vegetation as a consequence of the impact of rural land use and urban development.

Accordingly, significant scope exists for enhancing riparian vegetation as a way of assisting platypus conservation efforts. See recommended actions in:

- Protecting and restoring native riparian vegetation
- Capital works procedures
- Planning guidelines for riparian vegetation buffer zones

Impacts of development

Many types of development increase the rate at which stormwater runoff enters and leaves waterways, by expanding the amount of impervious surface in the catchment and/or directing runoff into creeks and rivers via stormwater drains. The resulting alteration of flow regimes, water quality and aquatic habitats can have serious negative impacts on platypus populations. For example, Serena and Pettigrove (2005) found that platypus fail to occupy streams in the Melbourne region characterised by more than 11% total catchment imperviousness, indicating that the species is sensitive to this factor. Similarly, Danger and Walsh (2008) concluded that the platypus is highly sensitive to catchment urbanisation, given that breeding populations are generally absent throughout the Melbourne area from sites with greater than 2.2% direct connected imperviousness (DCI, defined as the amount of impervious surfaces directly linked to natural streams or rivers by impervious stormwater pipes or channels in a given catchment area).

Other types of development, such as golf courses and horticultural complexes, have the potential to increase runoff of a wide variety of chemical contaminants, while elevated nutrients in stream water have been linked to seepage from septic tanks (Bernhardt *et al.* 2008).

Roads, walking tracks and car parks that are located inappropriately close to water bodies with inadequate intervening vegetation cover can substantially increase the risk that platypus are subject to attacks by predators such as foxes or uncontrolled dogs (Serena 1994). In addition, they can increase direct human disturbance of water bodies and associated impacts such as increased nocturnal noise and light, litter and other pollution, and trampling of burrows.

Toilet blocks and facilities associated with caravan parks and sporting ovals (e.g. dressing sheds, refreshment kiosks and waste receptacles, chemical and equipment storage sheds) located too close to waterways can increase the risk of pollution. Locating such eyesores in or close to the riparian zone can also degrade community appreciation of the value of creeks and rivers, including their role as platypus habitat.

Bright street lights or security lighting located near a creek or river may make platypus more easily detected by predators. In addition, by attracting the winged adults of some kinds of aquatic insect when they emerge at dusk to breed and lay eggs, it is possible that artificial lighting may effectively reduce the platypus's food supply.

In addition to the longer-term impacts of development on riparian areas, immediate problems may arise for platypus as a by-product of construction activities or routine maintenance (particularly if the latter involves substantial digging or other soil disturbance) carried out on creek or river banks. Based on studies examining the effect on platypus of major stream stabilisation projects, the animals normally do

not abandon their home ranges and adults are unlikely to be killed directly by heavy machinery used to restructure the banks and channel (Serena and Williams 1998a, 2000; Serena *et al.* 1999a).

However, special consideration must be given to the requirements of females with dependent offspring in the months from September to February, i.e. when eggs and/or dependent juveniles are found in nursery burrows (Grant *et al.* 1983). In this period females are unable to move their young. In consequence, major bank disturbance at or near the burrow may compromise the survival of mothers as well as their offspring.

Much of the Queanbeyan River is currently or potentially affected by the direct or indirect impacts of urban development. In order to conserve the local platypus population it is essential that a number of planning and management protocols are adopted in order to ensure the long-term health of the river environment.

See recommended actions in:

- Capital works procedures
- Designing and managing walking tracks, picnic areas and other public facilities
- Siting toilet blocks and other structures in sporting/recreational facilities
- Lighting
- Planning guidelines for development of buildings and other infrastructure near platypus habitat

Infrastructure in stream or river channels

Platypus typically occupy home ranges extending for a kilometre or (in most cases) more along a creek or river. Breeding males and dispersing juveniles have sometimes been known to move tens of kilometres over a period of days or weeks. In turn, these movements often require the animals to negotiate manmade structures.

Platypus have been observed to travel routinely through a concrete culvert measuring 45 metres in length (Serena *et al.* 1999b), and may also enter pipes as narrow as 10 centimetres in diameter, though they are apparently unable to back up or turn around in such a confined space and so can die if the pipe becomes blocked or shut at one end (Taylor *et al.* 1991).

The vertical walls of large concrete weirs or outflow structures (as exemplified by the main weir in Queanbeyan township) can create a very significant obstacle to platypus movement in the channel (Otley and le Mar 1998). Animals electing to move around such a barrier will need to exit the water, increasing their risk of being killed by predators. Platypus can also die after becoming wedged in gateways or mesh barriers placed across water bodies, such as one found drowned in a 5 centimetre gap in a gate regulating flow between two irrigation channels (APC, unpub. data).

Platypus are also known to die after being sucked into water pumps and water-powered generators, with many reports of this type of occurrence received by the APC. Ironically, the likelihood that small juveniles die in this unpleasant manner seems to be increased by the fact that pump and generator sheds are often sited on elevated banks which provide good habitat for nursery burrows.

See recommended actions in:

- Water pumps and water-powered generators
- Pipes, culverts and drop structures
- Planning guidelines for infrastructure in channels
- Platypus education program

Litter

Platypus are highly vulnerable to litter-caused injuries due to the specialised nature of the front feet, which are adapted to serve as highly efficient paddles. The trade-off is that the platypus is incapable of grasping objects with its “hands”. Platypus mainly forage by fossicking in bottom sediment, where items of litter tend to become concentrated, and consequently they run a high risk of getting plastic or rubber loops and rings (such as elastic hair ties, the tamper-proof sealing rings placed around the mouth of beverage and food containers, or loops of nylon fishing line) caught around their bill or head. Because the platypus is incapable of removing such objects by pulling them forward and off, they tend to work their way back along an animal’s body until they can’t move back further, then remain in place, gradually wearing their way through the skin and eventually into the underlying tissue. The APC has received numerous reliable reports of platypus drowning after tangled snarls of fishing line have become snagged on submerged roots or branches, and other individuals are known to have starved when small plastic rings (such as those found around the necks of milk bottles) become lodged around their bill.



Results of platypus live-trapping surveys conducted around Melbourne from mid-1998 through 2007 indicate that around 5% of platypus living in the greater urban area have at least one item of litter tangled around their body at any point in time, with litter removed from the bodies of up to one-third of animals captured along highly urbanised drainages in the 1990s (Serena and Williams 1998b, 2010). Based on the amount of litter observed in the Queanbeyan River during an inspection by APC biologists in March 2011, it is likely that similar levels of entanglement occur there.

Platypus have also been recorded with lacerations to the bill presumed to have been caused by encounters with jagged metal debris or broken glass in the water (Williams and Serena 2006).

Shopping trolleys are probably the commonest class of large metal objects dumped in QCC waterways. At least five dumped trolleys were noted in the Queanbeyan River during the March 2011 inspection by APC staff. While there are no recorded instances of platypus being killed or injured as a by-product of encounters with disintegrating trolleys, the presence of dumped trolleys undermines the public perception of a river as providing valuable wildlife habitat that needs to be conserved on behalf of platypus and other aquatic species.

A trolley deposit system (as implemented by Aldi supermarkets) provides a proven technology that works simply and effectively to virtually eliminate the dumping of trolleys in creeks and other public places.

In addition to possibly mandating this policy for local retailers, QCC should consider a range of other options for reducing litter. See recommended actions in:

- Litter traps
- Platypus education program

Inappropriate angling practices

There are numerous records of platypus being found dead after having been drowned in gill nets, eel nets and enclosed “opera house” traps set to catch yabbies or crayfish, with up to five platypus documented to die overnight in a single opera house trap (Grant *et al.* 2004; Serena and Williams 2010).

It is illegal to set opera house traps in public waters in eastern NSW and ACT but the practice appears to be common and widespread. Platypus which have drowned in yabby traps are often discarded on the banks and constitute the major class of intact (i.e. non-predated) platypus carcasses that are subsequently found (APC unpub. data). In Queanbeyan, such a carcass was reported this year in the White Rocks area (B. Medway, pers. comm.), which is reputedly also a focus for ad hoc camping activity throughout the warmer months (T. Rucosky Noakes, pers. comm.).



The APC has also received reports from many water bodies across the platypus's range of animals being found dead on the banks of a river or creek with a fish hook impaled in either the bill or a front foot. In other cases, platypus carcasses have been found floating underwater after trailing fishing line became wrapped around a piece of wood or other object and the animal either drowned or died of exhaustion. An example of this type of mortality occurred on 12 October 2011, when a female platypus was found in the Queanbeyan River near Dodsworth Street with a line and hook wrapped around its neck which was then snagged on an object below the surface of the water.

Platypus are also killed as a result of becoming entangled in discarded fishing line.

QCC should consider a number of actions to reduce the risk of platypus deaths and injuries related to angling. See recommended actions in:

- Recreational Angling and Yabbying
- Platypus Conservation Zone
- Platypus education program

Predation

Dogs and house cats have both been documented to kill platypus. In one study in Tasmania, dogs were found to be the leading cause of platypus deaths, accounting for 40% of known mortalities (Connolly *et al.* 1998). Naive juveniles are particularly likely to die in this manner (Serena and Williams 2010).

Foxes are also known to be responsible for platypus mortalities (Brown and Triggs 1990), with most victims probably attacked in areas of relatively shallow water (Serena 1994).

See recommended actions in:

- Dog control policies
- Planning guidelines for pet ownership
- Platypus Conservation Zone
- Platypus education program

Drought refuges and climate change

The platypus is adapted to feed only in the water. Accordingly, the possibility that flows along the Queanbeyan River may be compromised in future decades as a by-product of worsening and more frequent droughts could potentially compromise the survival of the local platypus population.

In general terms, platypus occupying waterways that possess sizable expanses of reliable refuge habitat are much more likely to survive exceptionally dry conditions. In the case of the Queanbeyan system, an excellent refuge currently exists in the form of water backed up behind the city's main weir, which appears to influence flow to approximately as far upstream as Dane Street. This expanse of habitat is undoubtedly one of the key factors (along with the reliable environmental flow currently released from Googong Dam) contributing to the sizable populations of platypus and water-rats found in Queanbeyan township. Water in this section of channel is (typically) quite slow-flowing and moderately deep, providing ideal platypus foraging habitat. Organic matter (in the form of branches, twigs and finer plant materials) which settles out in the slow-moving water is also predicted to provide the basis for a productive macro-invertebrate community, which in turn ensures a reliable food supply for the platypus and an important source of food for water-rats.

Two management questions have recently been raised in relation to management of the pool habitat found immediately behind the city weir:

- Is periodic mechanical removal of aquatic plants from the weir pool compatible with platypus conservation requirements?
- Would a dredging program for the weir pool benefit the local platypus population?

Although the presence of some macrophytes is predicted to benefit the platypus by providing habitat for macro-invertebrates, platypus undoubtedly forage much more effectively in relatively open water as compared to situations where a pool becomes choked with vegetation. The continued occurrence of substantial numbers of platypus and water-rats in and immediately upstream of the weir pool (as recorded by the *Platypus Count* monitoring program) also suggests, *prima facie*, that the aquatic plant removal regime has had no major deleterious impact on these species.

From the viewpoint of platypus, dredging a pool is likely to be quite negative over the short term because it will effectively destroy feeding opportunities until macro-invertebrate communities recover.

However, reflecting the fact that platypus are quite flexible in their feeding behaviour and have home ranges that typically encompass at least a kilometre of channel, this is unlikely to have catastrophic consequences for any individuals as long as substantial alternative feeding habitats are available to them (which is the case along the Queanbeyan.) Over the longer run, the animals are most likely to benefit if dredging increases the amount of pool habitat characterised by a depth of 1-4 metres, i.e. the ideal range for a platypus (Bethge *et al.* 2003; Grant 2004). Much of the weir pool currently appears to fall within these parameters. Accordingly, there would seem to be no compelling reason to undertake silt removal specifically with a view to improving the quality of platypus habitat at this point in time.

Based on the results from fish surveys (see section 2.2), Googong Dam also is likely to qualify as a potential platypus refuge in times of severe drought (particularly for those individuals living upstream of the dam), though animals are likely to be able to utilise only a fraction of this water body at any given point in time due to depth constraints (with platypus rarely reported to feed in water that is more than five metres deep: Bethge *et al.* 2003).

See recommended actions in:

- Maintaining drought refuges and environmental flows
- Planning guidelines for drainage
- Platypus education program

Inadequate awareness of platypus conservation needs

Most Australians are aware of the fact that the platypus is one of the world's most unusual animals. Ironically, this public awareness of the "special" nature of the species has helped foster a widespread misconception that platypus are only likely to be encountered in remote, pristine areas and that their conservation needs can be ignored in urban areas.

Developing a better community appreciation of the species' distribution and conservation needs in the Queanbeyan area is a key way in which the long-term survival of platypus populations can be fostered.

By the same token, it is important that current knowledge about best-practice platypus management be incorporated into council planning procedures and the routine management of city reserves and public lands.

See recommended actions in:

- Making provision for platypus in planning procedures
- Platypus Conservation Zone
- Platypus education program

PLATYPUS CONSERVATION GUIDELINES: WORKS PROTOCOLS AND MANAGING PUBLIC LAND

Platypus are currently present along the length of the Queanbeyan River within the QCC area. Consequently, it is important that the conservation needs of the species be routinely incorporated into the planning and day-to-day management of reserves and public lands which have frontage on the river and its major tributaries. This includes the activities of "Friends" and Landcare Groups or local Committees of Management, as well as the work of QCC staff and contractors.

In areas where river frontage is privately owned, land-owners should be provided with appropriate incentives to manage their land within the riparian corridor in accordance with the same protocols that apply to public areas.

Protecting and restoring native riparian vegetation

Recommendations

Whenever possible, a buffer zone of native riparian vegetation should be created or maintained (comprising a width of 30 metres on either bank) along the river and its major tributaries. Ideally this zone should be developed as a self-sustaining plant community comprising native trees as well as lower-growing plants (shrubs and ground covers) that overhang the water.

To deter predators and provide protective cover for native wildlife, shrubby vegetation overhanging the water should generally be encouraged to grow on all stream and river banks, including those located next to tracks, roads or footpaths. This is particularly important in places where the banks are relatively low and flat and the adjoining water body is relatively narrow and shallow (less than 3-4 metres wide and 0.5 metres deep). In the case of deeper and/or wider water bodies, it is recommended that, at the very least, a buffer strip of unmown grass at least two metres wide (though ideally more) should be encouraged to grow at the water's edge, ideally in conjunction with scattered clumps of taller growing plants.

In line with the above, QCC should establish a code of practice to discourage staff, contractors and community volunteers (and private land-owners) from mowing grassed lawn areas all the way to the water's edge unless there is a specific management imperative to do so (i.e. not simply because unmown grass looks "untidy").

Willows should be progressively removed from river and creek banks to improve the quality of platypus habitats. Areas where willows have been removed should be replanted as soon as possible with appropriate native trees and shrubs to reduce the potential for erosion. Care should be taken when carrying out willow removal programs in the period from September through February, particularly in areas known to support large numbers of platypus, to avoid damaging nursery burrows in the period when they are being used to incubate eggs and raise young.

The removal of other non-native tree species which are currently found along the urban river corridor is not considered a priority from the perspective of improving the quality of platypus habitat. Nevertheless, the implementation of a strategy to prevent the proliferation of potentially weedy species and establish more native vegetation in Queanbeyan is regarded as a sensible long-term goal to promote biodiversity in the region.

Where a target weed species dominates both banks for a substantial distance (e.g. 300 metres or more), consideration should be given to staging removal programs so the weed is eliminated from one bank in one year and the opposite bank in subsequent years, so some protective cover is maintained in that section of channel at all times. Areas where weeds have been removed should be replanted as soon as possible with appropriate indigenous trees and shrubs to reduce the potential for erosion.

Capital works procedures

Recommendations

Major construction or management activities which involve using excavators or other heavy equipment to dig into (or drive over) river banks within 10 metres of the water's edge should not be undertaken

during the platypus breeding season – i.e. from September through about February to avoid destroying nesting burrows containing females and their young.

Great care should be taken to reduce the movement of bare or disturbed soil from the banks to the water in the course of construction activities or management actions. Effective sediment traps should be erected, but it is important that these are removed upon completion of the work – e.g. hay bales, if used to trap sediment, should not be abandoned in the river so that baling twine becomes a hazard to platypus and other wildlife.

Areas of bare or disturbed soil should be replanted as quickly as possible with understorey plants and shrubs (as well as trees) to avoid erosion.

To enable natural bottom substrates to be accessible to foraging platypus, concrete should not be substantially employed as a binding agent along the banks or channel. Similarly, gabion baskets should not be employed over very extensive areas to stabilise banks if practical alternatives are available.

Designing and managing public facilities

In general terms, walking tracks should be constructed in accordance with the design principles detailed below.

Recommendations

To protect the ecological integrity of the river corridor and reduce the incidence of platypus mortality caused by foxes and other terrestrial predators, infrastructure such as roads, access tracks, car parks, caravan parks, picnic/playground areas and sports ovals should ideally be located at least 30 metres from the banks of the river and its major tributaries (and not less than 10 metres, apart from tracks or service roads leading to bridges or viewing platforms, see below).

The area between a footpath or other open public usage area and the bank of the river should be planted whenever possible with shrubs and/or thick ground cover plants to reduce easy access by humans and predators such as foxes and dogs (see section 4.1.2 for further advice).

To discourage the development of *ad hoc* trails down to the water and reduce access by predators, bridges and viewing platforms should ideally be placed at sites where the banks are relatively high and steep and water is reliably deep (at least 0.5 metres or more at the driest time of year). To provide protective cover for platypus in the vicinity of bridges, vegetation overhanging the water should be encouraged to grow along the banks upstream and downstream of the bridge for a distance of at least 20 metres in either direction.

Siting toilet blocks and other structures in sporting/recreational facilities

Some of the structures often associated with caravan parks and sporting ovals (such as toilet blocks, dressing sheds, refreshment kiosks and waste receptacles, and storage sheds) can both increase the risk of pollution and reduce community appreciation of the value of the river as a natural habitat for both platypus and water-rats if located too close to natural water bodies.

Recommendations

Future planning for toilet blocks and miscellaneous infrastructure associated with sporting and recreational facilities should ensure that such facilities are not placed within less than 30 metres of a creek or river.

Lighting

Recommendations

Security lights and floodlights located at parks, sporting and recreation venues, etc. that are located within 100 metres of the river and its major tributaries should be designed to minimise the amount of illumination directed over the water, and fitted with globes producing relatively low amounts of insect-attracting blue and ultraviolet light.

Water pumps and water-powered generators

Recommendations

QCC should conduct an audit of water pumps, water-powered generators and any other similar equipment associated with its operations to ensure that a mesh cover (or equivalent barrier) is fitted, and in good condition, at an appropriate distance around all intake points.

Pipes, culverts and drop structures

Recommendations

QCC should conduct an audit of infrastructure under city management to ensure that:

- Pipes and culverts located along the length of a natural water body or an earthen channel connected to a natural water body have a minimum internal diameter of 0.3 metre and do not project out from the surrounding substrate (i.e. do not create an overhang that cannot be negotiated by platypus).
- Pipes and culverts that are more than 50 metres in length are provided with vertical “breathing bays” at intervals of not more than 30 metres along their length if they are sometimes expected to be filled to capacity after storms.
- Grilles or mesh barriers placed across pipes and culverts located along a natural waterbody or an earthen channel connected to a natural water body (or across the width of a creek or earthen channel) have grid spacings or apertures that are 12 centimetres or more wide.
- Barriers meant to exclude platypus from pipes or artificial channels are constructed of solid materials or have grid spacings or apertures that are less than 2 centimetres wide.
- Concrete drop structures associated with culverts are designed with stepped or slanted faces to allow platypus to scramble up and down safely.

Consideration should be given over the longer term to install a fish ladder to facilitate safe passage of fish and platypus past the main Queanbeyan city weir. In general terms, any structure that can be navigated by a fish is likely to also be used by a platypus. Meanwhile, to help protect platypus from predators when they have to leave the water to move past the weir as it currently stands, it is strongly recommended that additional vegetation cover be planted at the edge of the weir (both sides) in the form of native shrubs and/or substantial tussock grasses (e.g. *Poa labillardieri*).

Recreational angling and yabbing

Recommendations

Signage concerning “platypus-friendly” angling practices should be erected at selected locations, especially the caravan park and at the pool immediately upstream of the main weir.

Information concerning “platypus-friendly” angling practices should be a key element in the platypus education program.

Consideration should be given to banning fishing along part or all of the Queanbeyan River over the longer term if there is reason to believe that angling is generating an unacceptable risk to platypus and other wildlife, as indicated by the presence of unattended lines or abandoned lures, hooks or tangled line along the river or by repeated discoveries (twice or more in five years) of platypus or other birds or mammals that have been injured due to use of fishing line or hooks.

Consideration should be given to instituting regular weekend and/or Monday morning patrols in the White Rocks area by appropriate QCC staff to help evaluate whether further action may be required to regulate camping-related activities.

Dog control policies

Recommendations

Dogs should be required to be controlled on a lead at all times when being exercised within 30 metres of the river in reserves or along walking tracks managed by Council, unless in a designated fenced off-lead dog area.

Maintaining drought refuges and environmental flows

The main Queanbeyan city weir should be retained as an important habitat feature for platypus at all times, and particularly during times of drought (see recommendations regarding installation of a fish ladder to improve connectivity along the channel, and measures to reduce the likelihood that platypus are subject to predation when traveling past the weir as it currently stands.)

Enough environmental flow should be released from Googong Dam during times of drought to support a viable platypus population downstream to at least the main city weir.

Periodic mechanical removal of excessive macrophyte growth in the city weir pool should continue, on the proviso that removal operations only occur during daylight hours and that harvested vegetation is largely removed from the site to preclude catastrophic reduction of dissolved oxygen levels due to decomposition.

Any future dredging operations carried out along the Queanbeyan River should ideally be scheduled outside the period when adult female platypus are engaged in raising young (September to February), to avoid potentially compromising reproductive success.

PLATYPUS CONSERVATION GUIDELINES: PLANNING and LOCAL LAWS

Environmental conditions that are right for the platypus, a generalised top predator, will also by definition favour a wide range of other native freshwater species. Accordingly, measures undertaken to protect or enhance the platypus’s environment should contribute to “best practice” management of biodiversity values along waterways.

QCC is unusual amongst city councils in that platypus occur extremely close to its CBD and major residential area. Accordingly, it is appropriate that planning procedures should routinely take the species’ requirements into account.

Making provision for platypus in planning procedures

Recommendations

Environmental Significance Overlays (ESO) for planning control purposes should include consideration of platypus conservation needs along the full length of the Queanbeyan River and the lowest 1-2 kilometres of each of its major tributaries (Buttles, Barracks and Jumping Creeks) given that platypus residing in the river are likely to occupy the latter areas regularly when flow is adequate.

Planning applications in the relevant zone should be specifically assessed in relation to the following potential impact upon platypus conservation requirements:

- Development of buildings or other significant infrastructure in riparian areas
- Removal of mature indigenous trees or tracts of native vegetation in riparian areas
- Design of storm water drainage or wastewater management systems that drain to natural water bodies
- Development of in-stream infrastructure such as pipes, culverts, gateways or pumps
- Pet control in urban growth areas located in or near riparian areas

Recommended guidelines with respect to each of these issues are provided below.

In the case of developments which are required to submit an Environmental Impact Statement (EIS) at the planning application stage, the EIS should specifically address the potential for platypus being negatively affected by the development either directly or indirectly (via their macro-invertebrate food supply). Depending on the nature of the development, it may also be appropriate to require a specific plan for platypus protection to be formulated as an integral part of the development approval process.

Planning guidelines for buildings and other infrastructure near platypus habitat

Recommendations

To protect the ecological integrity of stream and river corridors and reduce disturbance associated with human-generated light and noise, new buildings or other substantial structures (and their associated lawns, garden beds, etc.) should be located at least 30 metres from the banks of water bodies supporting platypus.

To protect the ecological integrity of stream and river corridors and reduce the incidence of platypus mortality caused by foxes and other terrestrial predators, roads and tracks should ideally be located at least 30 metres from the banks of water bodies supporting platypus (and never less than 10 metres, apart from those leading to bridges or viewing platforms, see below).

To discourage the development of *ad hoc* trails down to the water and reduce easy access by predators, bridges and viewing platforms should be placed at sites where the banks are relatively high and steep and water is reliably deep (at least 0.5 metres or more in the drier months of the year).

To protect the ecological integrity of stream and river and reduce predator impacts, car parks should ideally be located at least 30 metres from the banks of water bodies supporting platypus (and never less than 10 metres). Car parks serving commercial premises that are located less than 30 metres from the banks of a water body should be fenced in a manner which prevents litter from being blown or tossed onto the banks.

New sources of external lighting (street lights, security lights, etc.) located within 100 metres of a water body supporting platypus should be designed to minimise the amount of illumination directed over the water, and fitted with globes producing relatively low amounts of insect-attracting blue and ultraviolet light.

Major construction or maintenance activities which involve using excavators or other heavy equipment to dig into (or drive over) creek or river banks within 10 metres of the water's edge should not be undertaken along water bodies supporting a breeding platypus population from September through February (and ideally not until mid-March).

Planning guidelines for riparian vegetation buffer zones

Recommendations

To protect habitat integrity and reduce the level of disturbance associated with human-generated light and noise, a reserved area at least 30 metres wide should be maintained between the boundary of a new development (e.g. housing estate, recreational facility or commercial premise) and the margin of the river and its major tributaries. Special care should be taken to protect any existing native vegetation in this strip with a view to encouraging a self-sustaining plant community to develop, including mature specimens of the trees originally found in the habitat.

If time is required to establish a corridor of riparian vegetation at the edge of a new development, consideration should be given to fencing the riparian area at least until trees and shrubs are well established.

To deter predators and provide protective cover for native wildlife, shrubby vegetation overhanging the water should generally be encouraged to grow on all stream and river banks, including those located next to tracks, roads or footpaths. This is particularly important in places where the banks are relatively low and flat and the adjoining water body is relatively narrow and shallow (less than 3-4 metres wide and 0.5 metres deep). In the case of deeper and/or wider water bodies, it is recommended that, at the very least, a buffer strip of unmown grass at least two metres wide (though ideally more) should be encouraged to grow at the water's edge, ideally in conjunction with scattered clumps of taller growing plants.

To provide protective cover for platypus in the vicinity of bridges, native shrubs and ground covers overhanging the water should be encouraged to grow along the banks immediately upstream and downstream of the bridge for a distance of at least 20 metres in either direction.

Approval to remove or substantially lop indigenous trees that are growing within 20 metres of the river or its major tributaries should only be granted if the loss is offset by a substantial number of new indigenous trees planted along the riparian zone.

Planning guidelines for drainage

Recommendation

Storm run-off from new housing or industrial estates should not contribute to increased direct connected imperviousness in the Queanbeyan River catchment (i.e. should be treated in accordance with best practice water-sensitive urban design principles).

Proposed developments that entail the creation of new ponds, lakes or water retarding basins conforming to the specifications below should be required to formally investigate the possibility that the new water feature(s) can be designed in part to provide platypus feeding habitats:

- The new pondage is to be located within 100 metres of the Queanbeyan River.
- Its surface area will comprise 1000 m² or more.
- Water will be held to a depth of at least 0.5 metres for six or more months of the year.

Planning guidelines for infrastructure in channels

Recommendations

To assist safe passage by platypus along natural water bodies or earthen channels connected to natural water bodies, the following standards should apply to pipes and culverts located in the channel:

- Pipes and culverts should have a minimum internal diameter of 0.3 metre and should not project out from the surrounding substrate (i.e. should not create an overhang that cannot be negotiated by platypus).
- Pipes and culverts that are more than 50 metres in length should be provided with vertical “breathing bays” at intervals of not more than 30 metres along their length if they are sometimes expected to be filled to capacity after storms.
- Grilles or mesh barriers placed across pipes and culverts (or, more generally, across creeks) should have grid spacings or apertures that are 12 centimetres or more in width.
- Concrete drop structures associated with culverts should be designed with stepped or slanted faces to allow platypus to scramble up and down safely.
- Vertical concrete weirs should be designed to facilitate passage by platypus via the equivalent of a fish ladder.

Barriers meant to exclude platypus from pipes or artificial channels should be constructed of solid materials or have grid spacings or apertures that are less than 2 centimetres wide.

In the case of developments proposing the use of water pumps and/or on-stream water-powered generators, a condition of all approvals should be that a mesh cover (or equivalent barrier) with grid spacings or apertures of 2 centimetres or less should be fitted around all intake points.

Planning guidelines for pet ownership

At least one Melbourne council (City of Wyndham) has already made a ban on pet ownership a condition of approval for a housing development situated near an area of platypus significance.

Recommendation

QCC should consider placing restrictions on pet ownership as a condition of approval for any substantial new residential development located within 100 metres of the river.

PLATYPUS CONSERVATION GUIDELINES: COMMUNITY EDUCATION AND ECOTOURISM DEVELOPMENT

The platypus is a very powerful “flagship” for conserving freshwater environments. It can inspire strong community support for improving conditions along the river and addressing general environmental problems.

A number of measures are recommended for increasing the profile of platypus as an ambassador for biodiversity conservation in QCC.

Platypus Conservation Zone

Recommendations

The section of the Queanbeyan River stretching between Queens Bridge and the suspension bridge should be designated as a formal “Platypus Conservation Zone” in order to build public awareness of platypus in QCC and reinforce conservation efforts along the entire length of the waterway.

The Platypus Conservation Zone should comprise the following elements:

- Signage describing the status and conservation needs of the local platypus (and water-rat) populations. Particular emphasis should be placed on the positive role that the community can play in reducing wildlife mortality due to litter and inappropriate angling practices.
- Development of a designated platypus and water-rat viewing point (including signage with “spotting-hints”) which can also be used as the basis for ecotourism and monitoring activities. This would complement usage of the existing pedestrian swing bridge (which is not an ideal platform for wildlife viewing, given that it moves up and down in response to pedestrian traffic) for this purpose.
- Designation of the zone as a “No swimming” area for dogs and also as a “Dogs on lead only” area (in part, to minimise potential future conflict with platypus spotting groups).

Platypus education program

Platypus conservation needs are often neglected simply because the community is not aware of where the species might occur and how their activities affect the animals. Residents and visitors should be made aware of where platypus are found and procedures for:

- Reporting platypus sightings and how to get involved in platypus monitoring activities
- What to do upon finding an injured, displaced or dead platypus
- Reporting any illegal or inappropriate activities which may endanger platypus
- Obtaining advice in relation to specific matters which may have an impact on platypus or platypus habitat

Recommendations

The launch of the Queanbeyan PACS should be supported by a community education campaign to publicise the messages contained in the Strategy, e.g.:

- An information leaflet about platypus conservation in QCC to be circulated to all residents with rates notice (or distributed in a suitable alternative format such as being incorporated into a QCC newsletter/magazine)
- A poster containing key platypus conservation messages to be distributed for posting in schools and other public places
- A summary of key messages to be included on QCC web-site, linked to the APC site

Consideration should be given to organising regular public information sessions/training workshops about platypus conservation for members of QCC staff, relevant Landcare/Friends groups and interested members of the public.

Consideration should be given to organising an annual series of special classes for grades 3/4 in the QCC area about platypus conservation.

A program of collaboration should be developed with the caravan park to erect signs in the park about platypus conservation and provide all residents with platypus information.

A program of collaboration should be developed with Googong Dam to provide visitors with information about platypus in the Queanbeyan River.

All shops selling fishing equipment should be asked to provide customers with an information note about “platypus-friendly” angling procedures within QCC area.

A drainage stencil program featuring a platypus should be implemented to help reinforce the message that rubbish dropped in the street often ends up in the river.

Developing platypus-based ecotourism opportunities

Platypus and water-rats are both seen frequently at easily accessible locations along the Queanbeyan River – a relatively rare phenomenon in south-eastern Australia. Accordingly, there is a significant opportunity to promote Queanbeyan as a leading destination for spotting platypus and water-rats in the wild. The city’s proximity to Canberra, with its high proportion of international visitors, gives Queanbeyan an added market advantage.

Based on platypus-spotting activities in other areas, there is no reason to believe that properly conducted ecotourism would have any negative consequences for local wildlife. In turn, ecotourism would benefit the local economy and help boost community support for platypus conservation measures.

Recommendations

QCC’s economic development unit and local tourist promotion groups should be encouraged to examine ways of promoting Queanbeyan as a platypus-spotting destination.

QCC should help to organise/support (for a 2-3 year period) an annual program of platypus-spotting sessions and/or *Platypus Group Watch* events to serve as a pilot study for developing formal platypus-based ecotourism opportunities.

Subject to successful outcomes from the pilot study, QCC should call for expressions of interest for a license to operate a platypus-based ecotourism service in Queanbeyan.

Monitoring platypus numbers

Future monitoring of the Queanbeyan River’s platypus population is needed to help track how the population is faring (e.g. following unforeseen events such as the flooding that occurred in December 2010) and to measure the overall success of PACS actions.

In the case of relatively large waterways such as the Queanbeyan River, platypus live-trapping surveys are neither a cost-effective nor a sustainable way of achieving such monitoring. However, based on results to date, the *Platypus Count* program administered by the APC and Upper Murrumbidgee Waterwatch offers an effective way of tracking platypus numbers within the Queanbeyan River system.

In addition, systematic collection of records relating to opportunistic platypus sightings (including discoveries of dead platypus) provides valuable supplementary data which can potentially extend the

scope of *Platypus Count*. Encouraging the community to report sightings also contributes to overall awareness of platypus conservation and can potentially lead to the recruitment of new volunteers for the *Platypus Count* program.

Recommendations

QCC should become a formal partner (with the APC and Upper Murrumbidgee Waterwatch) in monitoring the status of platypus and water-rat populations in the Queanbeyan catchment. In particular, QCC should take primary responsibility for tracking and recording community reports of platypus sightings made outside of the *Platypus Count* program by:

- Actively encouraging residents to report platypus and water-rat sightings (especially of dead animals) as an integral part of directly engaging the community in platypus conservation
- Designating a member of staff to be responsible for maintaining the sightings database and ensuring that other QCC staff are aware of the procedure for passing on reports received from community members or made by council staff or contractors

Copies of a sightings report form and a mortality report form which are recommended for adoption by QCC are attached to this document.

Platypus emergency procedures

Platypus carcasses are occasionally discovered in or near the Queanbeyan River by members of the public or QCC staff. It is important that details of such discoveries are recorded in detail to ensure that issues relating to causes of mortalities are properly investigated and potentially highlighted in the local media.

Injured, sick or displaced platypus may also occasionally be encountered due to having a fishing hook lodged in the bill, litter entanglement, or exhaustion associated with juvenile dispersal or natural catastrophes such as floods. Providing timely and appropriate emergency care is likely to be crucial to their survival.

Recommendation

QCC should designate a staff position with specific responsibility for:

- Identifying and liaising with local veterinarians who are willing to be on call to handle any platypus requiring emergency treatment
- Identifying and liaising with local wildlife carers who can assist with safely transferring an injured platypus on short notice to a veterinarian
- Making alternative arrangements for an animal to be picked up without delay for veterinary examination if a wildlife carer is not available on a given occasion

Attached is a copy of a basic information sheet about platypus emergency care which is recommended for adoption by QCC.

Platypus-related conservation messages

Messages about key platypus conservation issues should be integrated into general QCC environmental education/community awareness programs, in order to capitalise on the potential of the species to serve as an ambassador for local biodiversity.

Major areas in which platypus can be used to highlight conservation messages include:

- Litter
- Fishing and related activities
- Responsible pet ownership
- Water pumps and water-powered generators
- Management of riparian corridors and private dams accessible to platypus

Recommendation

Key messages about platypus conservation should be integrated into QCC environmental education programs as follows:

Litter

Platypus (and other wildlife) die or suffer severe injuries after becoming entangled in litter.

All members of the community should be encouraged to reduce the negative impacts of litter on platypus by:

- Picking up litter from the environment, including that left by others
- Cutting through all loops of plastic, rubber or metal (e.g. 6-pack holders, tamper-proof ring seals on food and beverage containers) before disposing of them properly
- Organising and/or supporting “clean up” days in creekside areas

Fishing and related activities

Platypus (and other wildlife) are killed or injured by a range of fishing activities.

Both residents and visitors should be encouraged to follow responsible fishing practices including:

- Picking up all snarled or tangled line and disposing of it properly
- Moving a short distance upstream or downstream to avoid a platypus while angling
- Not cutting the line if a platypus becomes hooked but instead removing before the animal is released
- Using only appropriate and legal nets and lines for fishing and yabbying in public waters in QCC (i.e. no “opera house” or similar enclosed traps; no unattended hooked and baited lines)
- Encouraging landowners not to use “opera house” or similar enclosed traps in water bodies on private land (e.g. dams which may be used by platypus)
- Developing awareness of how to report all illegal and inappropriate fishing activities to Fisheries and Wildlife Officers

Responsible pet ownership

Domestic dogs and cats are both known to kill platypus (and other wildlife). Current responsible pet ownership guidelines should be strengthened to stress the importance for platypus of:

- Controlling the movements and behaviour of dogs and cats near lakes, rivers and streams
- Obeying on-leash regulations near lakes, rivers and streams
- Complying with curfew regulations
- Encouraging dogs to swim in public areas only at designated places

Water pumps and water-powered generators

Platypus (and other wildlife) can be killed after being sucked into water pumps and water-powered turbines. Owners of such equipment should be reminded to ensure that:

- Adequate guards are fitted around all intake points.
- Guards are checked (and repaired, if necessary) at least twice per year, but especially in late January (i.e. when small juvenile platypus start to emerge from nursery burrows).

Protecting and enhancing riparian corridors and private dams accessible to platypus

The condition of riparian habitat is directly linked to the health of platypus populations and of other wildlife species. In addition, farm dams and other such man-made ponds can make a valuable contribution to conservation of platypus (and other aquatic) by increasing the number of animals that an area can otherwise support and creating a reliable refuge habitat during drought.

Private landowners throughout the city should be encouraged to:

- plant native trees and shrubs in riparian areas and around dams (after removing willows and other non-native trees in an appropriate manner, if necessary);
- fencing off waterways and dams to prevent stock access (and replacing with off-stream watering points, as required);
- leaving dead trees and similar “snags” in water to provide a micro-habitat for aquatic invertebrates (the main food of platypus);
- minimising use of vehicles and heavy equipment near banks of waterways and dams;
- avoiding work within 10 m of a water body in the period September to February (when platypus mothers and their young may be in nursery burrows);
- ensuring that dam/weir walls are designed so as not to be a barrier to platypus movement and that all associated pipes and culverts are not a hazard to the animals;
- restricting access of pets to water bodies (see above);
- ensuring that all pumps and water-turbines are fitted with adequate in-take guards;
- preventing litter and pollutants from entering water bodies (especially “farm litter” such as bailing twine, empty chemical drums and discarded sacks, as well as old fencing wire and similar metal objects).

ACTION PLAN

The following plan has been designed to implement the PACS recommendations in an effective manner:

ACTION A. General Co-ordination

A.1. Designate a QCC staff position (hereafter referred to as PACS Co-ordinator) to have responsibility for co-ordinating the implementation of the PACS across QCC operations.

ACTION B. Works protocols and management of public land

B.1. PACS Co-ordinator to ensure that platypus conservation guidelines relating to works protocols and management of public land are circulated to all relevant QCC staff, contractors and local community environment groups, and to organise information sessions/training workshops

B.2. PACS Co-ordinator to ensure that suggested actions to protect and enhance environmental conditions for platypus are considered and implemented as far as possible by relevant QCC departments

B.3. PACS Co-ordinator to arrange for relevant QCC managers to conduct audits of water pumps, water-powered generators, etc. as well as pipes/culverts infrastructure.

B.4. Conduct a feasibility study into the installation of a fish ladder at the main Queanbeyan city weir and develop a plan for providing additional vegetation cover at the edges of the weir.

B.5. Initiate a review of the feasibility of appropriate QCC staff carrying out regular patrols in the White Rocks area.

B.6. Conduct a review of council animal control policies with particular regard to canine “on-leash” rules in riparian corridors, potential introduction of restrictions on pet ownership in new residential development near the river, and a “No swimming” area for dogs in the proposed Platypus Conservation Zone.

B.7. Establish a process of formal liaison with operators of Googong Dam regarding environmental flow policy.

B.8. Keep the macrophyte removal program under review and ensure that dates and details of operations are provided to the *Platypus Count* program so any impacts on platypus can be monitored.

B.9. Keep the need for dredging operations along Queanbeyan River under review and ensure that, if undertaken, such work is appropriately scheduled in relation to the timing of platypus reproduction and dates of operations are notified to *Platypus Count*.

ACTION C. Planning

C.1. PACS Co-ordinator to ensure that platypus conservation guidelines relating to planning and local laws are circulated to all relevant QCC staff for consideration and potential implementation.

ACTION D. Platypus Conservation Zone Project

D.1. Designate a formal Platypus Conservation Zone.

D.2. Formulate a plan for the Platypus Conservation Zone, including development of a viewing structure and informational signage.

D.3. Install signage outlining “platypus-friendly” angling practices.

ACTION E. Education

E.1. Produce an information leaflet and poster summarising key platypus conservation messages and add a summary of key messages on the QCC web-site.

E.2. Organise a trial series of platypus conservation classes for grades 3/4 students (to be developed into an ongoing program, if successful).

E.3. Implement a platypus-based drainage stencil program.

E.4. PACS Co-ordinator to work with Googong Dam staff to provide dam visitors with information about platypus in the Queanbeyan River.

E.5. Integrate messages about key platypus conservation issues into general QCC environmental education/community awareness programs.

ACTION F. Monitoring

F.1. Become a formal partner (with the APC and Upper Murrumbidgee Waterwatch) in monitoring the status of platypus and water-rat populations in the Queanbeyan catchment.

F.2. PACS Co-ordinator to develop and maintain a platypus and water-rat sightings database.

F.3. PACS Co-ordinator to ensure that appropriate platypus and water-rat emergency care procedures are formulated and easily accessed by council staff

F.4. PACS Co-ordinator to maintain records relating to platypus and water-rat mortalities in general and fishing-related mortalities in particular, so that appropriate consideration can be given to whether bans or restrictions on fishing should be introduced.

ACTION G. Ecotourism

G.1. Develop a strategy to highlight Queanbeyan as a platypus-spotting destination.

G.2. Organise a program of platypus-spotting sessions and/or *Platypus Group Watch* events (potentially in conjunction with Upper Murrumbidgee Waterwatch) to serve as a pilot study for developing formal platypus-based ecotourism opportunities.

G.3. Subject to successful outcomes from the pilot study, call for expressions of interest for a license to operate a platypus-based ecotourism service in Queanbeyan.

ACTION H. Liaison with local businesses

H.1. PACS Co-ordinator to develop a collaborative program with the local caravan park to erect signs in the park about platypus conservation and “platypus-friendly” angling and provide residents with platypus information.

H.2. PACS Co-ordinator to develop a collaborative program with shops selling fishing equipment to provide customers with an information note about “platypus-friendly” angling procedures.

LITERATURE CITED

- Bernhardt, E.S., Band, L.E., Walsh, C.J. and Berke, P.E. (2008). Understanding, managing, and minimizing urban impacts on surface water nitrogen loading. *Annals of the New York Academy of Sciences* 1134: 61-96.
- Bethge, P., Munks, S., Otley, H. and Nicol, S. (2003). Diving behaviour, dive cycles and aerobic dive limit in the platypus *Ornithorhynchus anatinus*. *Comparative Biochemistry and Physiology Part A* 136: 799-809.
- Brown, G.W. and Triggs, B.E. (1990). Diet of wild canids and foxes in East Gippsland 1983-1987, using predator scat analysis. *Australian Mammalogy* 13: 209-213.
- Burrell, K.H., Isely, J.J., Bunnell, D.B. Jr., Van Lear, D.H. and Dolloff, C.A. (2000). Seasonal movement of brown trout in a southern Appalachian river. *Transactions of the American Fisheries Society* 129: 1373-1379.
- Connolly, J.H., Obendorf, D.L., Whittington, R.J. and Muir, D.B. (1998). Causes of morbidity and mortality in platypus (*Ornithorhynchus anatinus*) from Tasmania, with particular reference to *Mucor amphibiorum* infection. *Australian Mammalogy* 20: 177-187.
- Danger, A. and Walsh, C.J. (2008). Management options for conserving and restoring fauna and other ecological values of urban streams in the Melbourne Water region. (Report to Melbourne Water). Department of Resource Management and Geography, University of Melbourne.
- Ellem, B.A., Bryant, A. and O'Connor, A. (1998). Statistical modelling of platypus (*Ornithorhynchus anatinus*) habitat preferences using generalised linear models. *Australian Mammalogy* 20: 281-285.
- Faragher, R.A., Grant, T.R. and Carrick, F.N. (1979). Food of the platypus (*Ornithorhynchus anatinus*) with notes on the food of brown trout (*Salmo trutta*) in the Shoalhaven River, N.S.W. *Australian Journal of Ecology* 4: 171-179.
- Fleay, D. (1980). Paradoxical Platypus. (Jacaranda Press: Milton, Qld)
- Gardner, J.L. and Serena, M. (1995). Spatial organisation and movement patterns of adult male platypus, *Ornithorhynchus anatinus* (Monotremata: Ornithorhynchidae). *Australian Journal of Zoology* 43: 91-103.
- Grant, T.R. (2004). Depth and substrate selection by platypuses, *Ornithorhynchus anatinus*, in the lower Hastings River, New South Wales. *Proceedings of the Linnean Society of New South Wales* 125: 235-241.
- Grant, T.R. and Carrick, F.N. (1974). Capture and marking of the platypus, *Ornithorhynchus anatinus*, in the wild. *Australian Zoologist* 18: 133-135.
- Grant, T.R., Griffiths, M. and Leckie, R.M.C. (1983). Aspects of lactation in the platypus, *Ornithorhynchus anatinus* (Monotremata), in waters of eastern New South Wales. *Australian Journal of Zoology* 31: 881-889.
- Grant, T.R., Lowry, M.B., Pease, B., Walford, T.R. and Graham, K. (2004). Reducing the by-catch of platypuses (*Ornithorhynchus anatinus*) in commercial and recreational fishing gear in New South Wales. *Proceedings of the Linnean Society of New South Wales* 125: 259-272.

- Holwell, G., Serena, M. and Williams, G.A. (1998). Ecology and conservation of platypus in the Wimmera River catchment. II, Results of radio-tracking studies, winter 1998. (Report to Earthwatch Australia and Rio Tinto Project Platypus). Australian Platypus Conservancy, Whittlesea.
- Lintermans, M. and Jekabsons, M. (2004). A survey of fish in the lower Queanbeyan River. (Report to Queanbeyan City Council). Environment ACT Wildlife and Research Monitoring, Lyneham.
- Lintermans, M., Jekabsons, M. and Morris, B. (2001). A survey of fish in the lower Queanbeyan River. (Report to Queanbeyan City Council). Environment ACT Wildlife and Research Monitoring, Lyneham.
- Otley, H.M. and le Mar, K. (1998). Observations on the avoidance of culverts by platypus. *The Tasmanian Naturalist* 120: 48-50.
- Read, M.G. and Barmuta, L.A. (1999). Comparisons of benthic communities adjacent to riparian native eucalypt and introduced willow vegetation. *Freshwater Biology* 42: 359-374.
- Serena, M. (1994). Use of time and space by platypus (*Ornithorhynchus anatinus*: Monotremata) along a Victorian stream. *Journal of Zoology, London* 232: 117-131.
- Serena, M. and Pettigrove, V. (2005). Relationship of sediment toxicants and water quality to the distribution of platypus populations in urban streams. *Journal of the North American Benthological Society* 24: 679-689.
- Serena, M. and Williams, G.A. (1997). Effect of willow removal works on platypus along Diamond Creek and adjoining sections of the Yarra River. (Report to Melbourne Water). Australian Platypus Conservancy, Whittlesea.
- Serena, M. and Williams, G.A. (1998a). Effect of stream stabilisation works on platypus along Diamond Creek (Yarra River catchment). (Report to Melbourne Water). Australian Platypus Conservancy, Whittlesea.
- Serena, M. and Williams, G.A. (1998b). Rubber and plastic rubbish: a summary of the hazard posed to platypus *Ornithorhynchus anatinus* in suburban habitats. *The Victorian Naturalist* 115: 47-49.
- Serena, M. and Williams, G.A. (1999). Formulation of a reintroduction strategy for platypus in the Melbourne metropolitan region. (Report to Melbourne Water). Australian Platypus Conservancy, Whittlesea.
- Serena, M. and Williams, G.A. (2000). Effects of substantial channel works on platypus behaviour along Olinda Creek (Yarra River catchment): post-works monitoring, summer 2000. (Report to Melbourne Water). Australian Platypus Conservancy, Whittlesea.
- Serena, M. and Williams, G.A. (2008). Distribution and management of platypus in the Greater Melbourne region. (Report to Melbourne Water). Australian Platypus Conservancy, Wisesleigh.
- Serena, M. and Williams, G.A. (2010). Factors contributing to platypus mortality in Victoria. *The Victorian Naturalist* 127 (5): 178-183.
- Serena, M., Thomas, J.L. and Williams, G.A. (1998a). Status and habitat relationships of platypus in the Dandenong Creek catchment: II. Results of surveys and radio-tracking studies, September 1997 – March 1998. Australian Platypus Conservancy, Whittlesea.

Serena, M., Williams, G.A. and Worley, M. (1999a). Effect of substantial channel works on platypus behaviour along Olinda Creek (Yarra River catchment). (Report to Melbourne Water). Australian Platypus Conservancy, Whittlesea.

Serena, M., Swinnerton, M., Worley, M. and Williams, G.A. (2000). Results of surveys and habitat studies along Running Creek, summer 2000. (Report to Melbourne Water). Australian Platypus Conservancy, Whittlesea.

Serena, M., Swinnerton, M., Worley, M. and Williams, G.A. (2001a). Attributes of preferred foraging habitats of platypus (*Ornithorhynchus anatinus*). Pp. 565-570 in *Proceedings of the Third Australian Stream Management Conference*. Rutherford, I., Sheldon, F., Brierley, G., and Kenyon, C. (eds), Melbourne.

Serena, M., Thomas, J.L., Williams, G.A. and Officer, R.C.E. (1998b). Use of stream and river habitats by the platypus (*Ornithorhynchus anatinus*) in an urban fringe environment. *Australian Journal of Zoology* 46: 267-282.

Serena, M., Williams, G., Thomas, J. and Worley, M. (1999b). Effect of a flood retarding basin culvert on movements by platypus *Ornithorhynchus anatinus*. *The Victorian Naturalist* 116: 54-57.

Serena, M., Worley, M., Swinnerton, M. and Williams, G.A. (2001b). Effect of food availability and habitat on the distribution of platypus (*Ornithorhynchus anatinus*) foraging activity. *Australian Journal of Zoology* 49: 263-277.

Taylor, R., Mooney, N. and Lange, K. (1991). Observations on platypus. *The Tasmanian Naturalist* 105: 1-3.

Worley, M. and Serena, M. (2000). *Ecology and conservation of platypus in the Wimmera River catchment*. IV. Results of habitat studies, summer 1999. (Report to Rio Tinto Project Platypus). Australian Platypus Conservancy, Whittlesea.

APPENDIX A: SUGGESTED ACTIONS TO PROTECT AND ENHANCE ENVIRONMENTAL CONDITIONS FOR PLATYPUS

There does not appear to be any immediate threat to the survival of the species in Queanbeyan. Nevertheless, it is still prudent to take steps to safeguard the long-term future of platypus within the QCC area, particularly at a time of uncertainty over future climate change, it is sensible to develop an overall plan to protect Queanbeyan's platypus. This plan should be based on three main elements:

- Protection of environmental conditions in the upper section of the Queanbeyan River to ensure that it remains capable of supporting a core breeding population – i.e. not less than 30 adult/subadult platypus – in the long term.
- Improvement to environmental conditions where possible in the middle section of the Queanbeyan River to increase the number of platypus it can support.
- Enhancement of environmental conditions along the lower section of the Queanbeyan River to maintain and improve connectivity with the adjoining sections of the Molonglo River (where habitat rehabilitation should also be encouraged). Such action will reduce the risk that platypus in the Queanbeyan and Molonglo Rivers become separated from each other, resulting in fragmented populations.

Upper section (Googong Dam to White Rocks)

Environmental conditions in the upper section are generally good for platypus. Water quality is high (albeit with some evidence of temperature fluctuations related to releases from Googong Dam). In-stream habitat is complex, with natural pool/riffle/run sequences which encourage diversity of aquatic invertebrates. Carp (which potentially compete with platypus for food) appear to be absent from much of the section, thanks to a barrier at an unknown location which appears to have checked the upstream migration of this introduced fish species (Lintermans and Jekabsons 2004).

The quality of the riparian vegetation is generally high, with only a relatively small amount of invasion by non-native trees, shrubs and weeds. As a consequence, river banks are generally well stabilised (thereby providing good conditions for platypus burrows) and a considerable supply of organic matter and woody debris falls into the water to provide food for aquatic invertebrates (the main prey item for platypus).

Settlement is at low density in this part of the river corridor, with relatively little evidence of human impact. Access to the river is generally difficult.

Given that conditions for platypus are already fairly good, relatively little scope exists for cost-effective habitat improvement in the upper section. Accordingly, the key commitment required from QCC is to ensure that there is no loss of environmental quality.

Suggested actions:

- QCC should ensure that all planning applications which have the potential to impact in any way on the upper section are subject to special consideration with regard to platypus.
- A full survey of weed infestation (with particular focus on willows) in the upper section should be commissioned as soon as possible.
- QCC should develop a public access plan for the upper river (including closing off informal tracks where feasible).

Middle section (White Rocks to city weir)

Platypus appear to be reasonably abundant in the middle section despite the fact that riparian habitat has been substantially modified and human-related impact is high. Because there is scope for improving environmental conditions, this section could potentially support more resident platypus than at present, thereby boosting the overall size of the river's population.

Habitat enhancement – White Rocks to Suspension bridge

Conditions for platypus in the Queanbeyan River's middle section can be enhanced through strengthening riparian habitat by selective planting of indigenous trees and shrubs. An appropriate model for this process is provided by the riverside area on the western bank, upstream of the suspension bridge – i.e. near the outdoor "amphitheatre". Planting by Queanbeyan Landcare has created an effective buffer zone of native vegetation (which will ultimately out-compete the remaining introduced vegetation) and has greatly improved bank stability.

Community access to the river upstream of Dane Street needs to be formalised. The path from Barracks Flat parallel to River Drive is well sited at a considerable distance from the water with a good vegetation buffer zone in the process of becoming established. However, the formal path system currently peters out in the vicinity of Doeberl Reserve and turns into a number of informal tracks to the water which encourage access by predators and people.

Suggested actions:

- Riparian buffer zone re-planting should continue upstream of the suspension bridge, on both banks of the river, where feasible, as far as White Rocks. This is especially important in places where extensive willow removal has already occurred. The process should also include the riverside area of the Golf Club, where the existing riparian buffer zone could usefully be strengthened to improve protection for platypus.
- In the area where a number of properties apparently have title to the middle of the river (on the western side, upstream of Glebe Park), land-owners should be encouraged to manage their river frontage in accordance with specified native vegetation guidelines in order to prevent further loss of riparian habitat to domestic gardens and/or weed infestation.
- Public access at the upstream end of River Drive (near Doeberl Reserve) should be reviewed to improve public amenity and potentially reduce impact on platypus related to the current network of informal tracks.

Habitat enhancement – Suspension bridge to Queens Bridge

From the suspension bridge to Queens Bridge, it is much more difficult to undertake major revegetation without seriously curtailing existing community usage of the riverside zone. Despite this, conditions for platypus could be improved substantially by adopting the following actions:

- Native vegetation should be re-planted so as to establish riparian buffer zones on at least one side of the river (and on both sides where possible) along the entire length of the suspension bridge-Queens Bridge reach. However, such plantings should be at points selected to cause minimal loss of community amenity.
- The current practice of mowing to the water's edge along much of this reach should be eliminated, so as to leave an unmowed strip at least 2 metres wide near the water's edge.

- Many of the informal tracks at the water's edge (especially on the eastern bank) should be replaced with a fully formalised path system.

Habitat enhancement – Queens Bridge to city weir

Platypus are rarely seen in the short reach between Queens Bridge and the main city weir. This may reflect that fact that conditions are generally somewhat shallow because of silt deposition and that levels of human disturbance (including extensive public access to the water's edge, angling, traffic noise, light pollution and litter) are relatively high.

Nevertheless, this is an important area for platypus conservation in the river as a whole, since passage by animals through the pool and across the weir is vital for maintaining connectivity between the Queanbeyan River and the wider Molonglo catchment.

Suggested actions:

- A narrow native vegetation buffer zone should be planted immediately in front of the Collett Street car-parking area to reduce noise and light pollution from vehicles and trap litter blowing from the shopping centre area.
- Small vegetation zones should be planted near the water at the bridge and weir ends of the “beach” on the eastern bank.
- The amount of lighting from buildings and street-lamps that shines onto the water in this area should be reduced.
- Dense plantings should be developed on either side of the weir to provide increased cover. This is particularly important on the caravan park side of the weir, where the slope is less steep and thus more likely to be preferred by platypus. This area should also then be fenced off to prevent trampling of planting by caravan park residents and to reduce human usage (especially at night).

Lower section

The lower section of the Queanbeyan River, from downstream of the weir to the Molonglo confluence, currently appears to support the lowest numbers of platypus. Accordingly, this section offers the best opportunity to boost carrying capacity of the river and to strengthen the population's connectivity with the rest of the Molonglo system.

Key opportunities throughout this section include:

- removing current infestations of willows and other introduced species and replacement with a riparian buffer of native vegetation
- addressing problems of litter and stormwater run-off
- formalising paths and general community access to the river

Weir to Morriset Street bridge

As described above, safe access for platypus while crossing the city weir is a key issue for long-term conservation. However, the area immediately below the weir is also currently highly problematic for platypus movement, especially as the low weir situated 30 metres downstream of the main weir poses another barrier, thereby further increasing risk of predation. The general lack of a riparian vegetation buffer zone in this reach compounds the problem.

The caravan park creates a high level of potential human impact on the river as a result of informal tracks to the water's edge, camp fires near the water, litter and fishing activities. Most caravan park visitors would be unaware of the presence of platypus in the river and some from inter-state may be unfamiliar with NSW fishing regulations (especially travellers from Queensland, where use of opera house traps is unrestricted).

Suggested actions:

- The relocation of the caravan park to a new site in the long-term should be examined so that this key area of river frontage can be reclaimed for community usage and environmental purposes.
- The caravan park should be required to collaborate on work to enhance native vegetation in the riparian zone, especially around the end of the main weir and near the minor weir, and to establish formal access points to the river to replace the existing *ad hoc* arrangements.
- Revegetation should undertaken on both banks immediately upstream and downstream of Morriset Street bridge to impede access to the river by potential predators and to screen noise and lights from traffic.

Morriset Street bridge to railway bridge

Significant opportunities exist along this reach to enhance conditions for platypus in the long-term. In particular, riparian habitat can be greatly enhanced and water quality potentially improved.

The main pathway along this reach is generally well sited and at a good distance from the river but there are a number informal access points to the water which potentially encourage human disturbance.

Suggested actions:

- Efforts to remove willow infestations and re-plant with native revegetation should be a priority in this reach.
- Community access to the river should be formalised with appropriate buffer plantings and a number of informal access points closed off.
- Stormwater inflows, especially the main drain which enters from the Antill Street direction, should be assessed to see if they can be fitted with a litter trap.
- The possibility of diverting some stormwater run-off into filtration ponds/wetlands – for instance at the Morriset Street crossing and the aforementioned main drain – should be investigated.

Railway bridge to Molonglo confluence

This reach of the Queanbeyan River is not within the boundaries of QCC. However, it is essential that QCC develop a program of co-operation with ACT Government to ensure that common management principles are applied in this area, given that connectivity between platypus populations in the Queanbeyan and Molonglo Rivers is of vital importance.

Suggested action:

- QCC should encourage ACT Government to implement a long-term program to remove willow infestations, to formalise walking tracks and community access and to remove build up of litter from the river.

DETAILED COMMENTS CONCERNING PLATYPUS HABITAT ACTIONS

Refer to map for photopoint locations.

Middle section (White Rocks to city weir)

Photopoint 1.1. view upstream from southern end of Barracks Flat PI.



The reach of the river upstream of the southern end of Barracks Flat Place shows some evidence of human incursion from the western side, with potential impact on platypus – e.g. litter, possible illegal fishing activities.

A community access policy needs to be formulated for this suburban fringe area.

Photopoint 1.2. View across river to mouth of Jumping Creek



Platypus are currently unlikely to be present in Jumping Creek on a permanent basis, although occasional use may occur when flows are adequate.

It would be sensible to protect and enhance riparian habitat along the lowest reach of Jumping Creek (i.e. starting c. 1 km from the river) by re-planting a native vegetation buffer and potentially fencing-off from stock access. This would create additional usable habitat for the Queanbeyan River platypus population.

Photopoint 1.3. View upstream from southern end of Doeberl Reserve



The formal path system currently ends near Doeberl Reserve. Various informal access tracks to the river have been created upstream of this area, leading to potential impact on riparian habitat and on platypus – e.g. litter, possible illegal fishing activities.

Future public access to this area needs careful consideration to ensure environmental values are protected.

Photopoint 1.4. River Drive area (looking downstream)



The formal path running parallel to River Drive is sited at a good distance from the river and previous plantings are developing into a good riparian vegetation buffer zone.

This pool area is potentially a prime area for platypus. Accordingly, some additional planting of low, thick shrubs in the 2-3 metres closest to the water would further improve protection for platypus from predators and enhance conditions for burrows.

Photopoint 1.5. View up Barracks Creek from its confluence with river



Platypus are currently unlikely to be resident in Barracks Creek on a permanent basis, although occasional use may occur when flows are adequate.

It would be sensible to protect and enhance riparian habitat along the lowest 1 km reach of Barracks Creek by re-planting a native vegetation buffer and formalising community access to the area (including the crossing point for the path over the mouth of the creek).

Photopoint 1.6. View upstream from c. 200 m south of Dane Street



Extensive willow removal has been carried out in the reach between Dane Street and the Barracks Creek confluence. A small amount of re-planting has occurred but many additional native trees and shrubs are urgently needed on both sides of the river to improve platypus habitat. This is particularly important in areas where sandy, unstable banks predominate (to improve future platypus burrow opportunities) and where the existing path on the western side runs relatively close to the river bank (to improve protection for platypus from predators and human disturbance).

Photopoint 1.7. View from Dane Street looking downstream



Additional planting of trees and shrubs on the eastern side is desirable to increase bank stability and provide a buffer between the river and the rough track running along the top of the bank.

Photopoint 1.8. Queanbeyan Golf Club frontage



The Golf Club should be encouraged to commit to having a continuous zone of riparian native vegetation along its entire length of river frontage. This would help eliminate existing areas of potential bank instability and improve opportunities for platypus burrows.

It is particularly important that re-planting with native trees and shrubs is undertaken as soon as possible in areas where willow removal has been carried out (including on the western side of the river, as well as

the Golf Club bank).



Photopoint 1.9. "Private" riparian reach (looking upstream from Glebe Park southern boundary)



In the area on the western side of the river, upstream of Glebe Park, a number of properties apparently have title to the middle of the river.

Along this reach, areas of riparian habitat have been "domesticated" by planting of introduced trees and shrubs, often with associated weed infestation.

Land-owners should be encouraged to manage their river frontage in accordance with specified native vegetation guidelines in order to prevent further loss of riparian habitat.

Photopoint 1.10. Suspension Bridge area (looking upstream to Glebe Park)



Habitat conditions for platypus are generally good in the reach immediately upstream of the suspension bridge, although some scope exists for improving riparian vegetation in the Glebe Park area.

The habitat rehabilitation work undertaken by Landcare on the western side of the river, immediately upstream of the suspension bridge, provides a general blueprint for other reaches where strengthening of the riparian buffer zone is desirable.



Although some non-native trees remain in this reach, they are generally now being outcompeted by native re-plantings and their presence is not a significant factor in terms of platypus habitat. However, gradual removal of any remaining willows is still desirable in the overall context of willow control.

Photopoint 1.11. Suspension bridge area – views of eastern bank, downstream of bridge



If possible, buffer zones of native vegetation should be re-established on at least one side of the river along the length of the suspension bridge-Queens Bridge reach. Revegetated habitat will favour the establishment of platypus burrows and provide protection against predators and human disturbance.



A prime area for this type of rehabilitation is the bank on the eastern side, immediately downstream of the suspension bridge (see above). This bank is steep and not really safe for public access. It currently lacks a good cover of vegetation, thus making it potentially vulnerable to erosion.

A dense cover of low-growing plants would greatly improve conditions for platypus without interfering with views of the river from nearby residences. Informal tracks close to the water's edge in this area should be eliminated.

Photopoints 1.12. Views from Queens bridge looking upstream



At the downstream end of this reach – i.e. close to Queens Bridge – considerable scope also exists for planting buffer zones of riparian native vegetation, especially near the children's playground on the eastern bank and in selected spots between the path and river's edge on the western bank. The practice of mowing almost to the water's edge along much of this reach should be eliminated, leaving an unmowed strip at least 2 metres wide near the water.



Photopoint 1.13. Views from downstream of Queens Bridge of “beach area” on eastern bank and shopping centre parking area on western bank



The current “beach” area on the east bank represents a considerable length of cleared riparian area offering little cover for platypus against predators and human-related disturbance (including lighting from the bridge and shopping centre). Establishment of several small zones of native vegetation (similar in scale to the one close to the bridge on the western bank) would improve conditions for platypus without compromising community access.

A low screen of vegetation should be planted on the western bank in front of the car-parking strip outside the shopping centre to reduce human impact on the riparian area.

Likewise, additional planting between the path and river’s edge on the west bank would help to screen the caravan park and reduce its human impact on platypus.

Photopoint 1.14. Main city weir



Platypus probably negotiate the weir by clambering around on the western side – i.e. via the grounds of the caravan park. In doing so they are highly vulnerable to predators and human-related problems. The area around the end of the weir should be fenced off from the caravan park and heavily planted to provide more cover for platypus in transit.



Lower section (city weir to Molonglo confluence)

Photopoint 2.1. Small weir/caravan park area



The small weir near the caravan park is another spot where platypus are highly vulnerable to predators and human-related problems.



The areas on both sides of the weir should be heavily planted to provide more cover for platypus in transit.



The caravan park potentially creates a high level of human-related disturbance in a key area for platypus movement along the river.

Until the caravan park can be re-located to a more appropriate site, the lease-holders should be required to collaborate on work to enhance native vegetation in the riparian zone and to establish formal access points to the river to replace existing *ad hoc* arrangements.

Photopoint 2.2. Morriset Street bridge area

Revegetation should undertaken on both banks immediately upstream and downstream of Morriset Street bridge to impede access to the river by potential predators, reduce human disturbance and screen noise and lights from traffic.



a) view downstream to Morriset Street bridge



b) view upstream to Morriset Street bridge

Efforts to remove willow infestations and re-plant with native revegetation should be a priority in the entire reach from Morriset Street to the railway bridge.

Photopoint 2.3.a) views of “beach area” approximately 100m downstream of Morriset Street, showing willow infestation and lack of cover for platypus for a lengthy stretch on western bank



Appropriate buffer plantings are required in open “beach areas” to reduce human-related impacts on platypus.



Photopoint 2.3.b) informal tracks and lack of cover for platypus on eastern bank



The main pathway along this reach on the western side is generally well sited and at a good distance from the river.

However, community access to the eastern side needs formalising and appropriate buffer zones developed to reduce human impact on platypus.

Photopoint 2.3.c) main drain outflow (from Antill St area)



Stormwater inflows, especially the main drain which enters from the Antill Street direction, should be assessed to see if they can be fitted with litter traps (see photos of litter build up in river, below).



The possibility of diverting some stormwater run-off into filtration ponds/wetlands should be investigated, particularly at the aforementioned main drain, (see photo, above, of view from main drain across river) and the Morriset Street crossing.



Photopoint 2.3.a.d) "beach area" on western bank near upstream end of cemetery

Community access to the river from the cemetery area should be formalised with appropriate buffer plantings and a number of informal access points closed off.



Photopoint 2.3.e) view upstream from near railway bridge

Efforts to remove willow infestations and re-plant with native revegetation should be a priority throughout all this reach but especially around the deeper pools (e.g. upstream of the railway bridge) which potentially provide good foraging areas for platypus.

Photopoint 2.4. view upstream to railway bridge



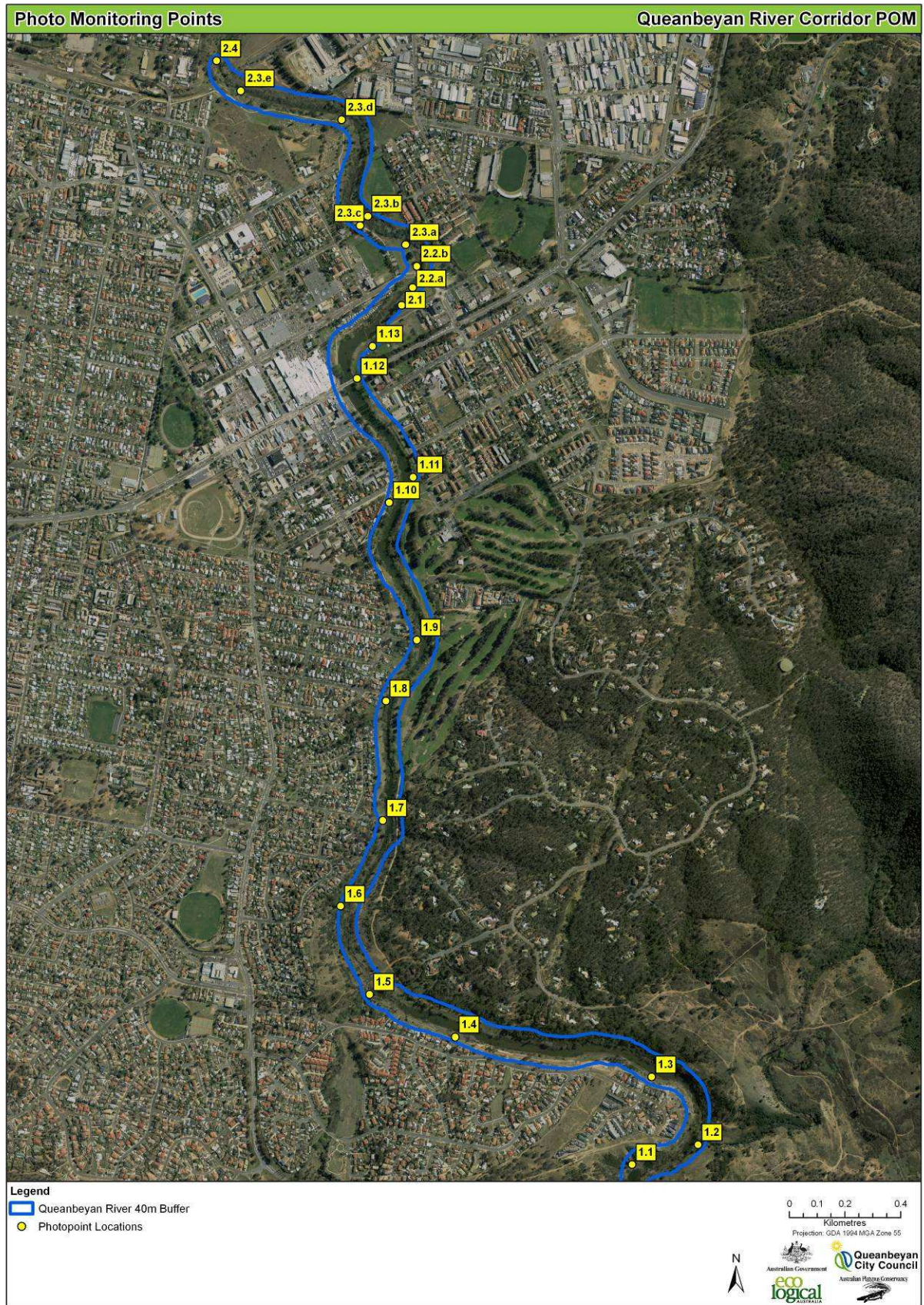
Removal of willow infestations should be a long-term goal along this entire section from the railway bridge to the Molonglo confluence.

Community access needs to be formalised with well sited walking tracks and programs to clean-up litter from the river.

Photopoint 2.5. Molonglo confluence



Confluence areas tend to be of special importance for platypus movement and are often favoured foraging spots. Riparian habitat around the Molonglo confluence is generally poor and needs to be a priority for riparian rehabilitation work.



Appendix B: PLATYPUS CONSERVATION ZONE – OUTLINE PROJECT BRIEF

BACKGROUND

Platypus and Australian water-rats are both seen frequently in the Queanbeyan River, including that part of the river located close to the city centre. There is accordingly a significant opportunity to promote Queanbeyan as a leading destination for spotting these two attractive native species in the wild. The city's proximity to Canberra, with its high proportion of international visitors, gives Queanbeyan an added market advantage. Based on platypus-spotting activities in other areas, there is no reason to believe that properly conducted ecotourism would have any negative consequences for the wildlife being observed. Such ecotourism would benefit the local economy and help boost community support for platypus conservation measures.

In addition, by highlighting the occurrence of platypus in the river, the popularity of this iconic species can contribute to building local support for actions to improve environmental conditions along the river.

Accordingly, it is recommended that a formal Platypus Conservation Zone (PCZ) be established along the Queanbeyan River between Queens Bridge and the suspension bridge. This Zone will serve as a focus for ecotourism activities and enhance public awareness of platypus conservation requirements.

PROJECT OUTLINE

The Platypus Conservation Zone should comprise the following elements:

1) Viewing platform

The suspension bridge already provides a good elevated spot for trying to observe platypus and some signage should be placed in this location to highlight its potential as a viewing area (see below). However, the swaying motion and creaking associated with this structure make it less than ideal. Likewise, Queens Bridge is an unsatisfactory area for viewing because of its close proximity to traffic noise and fumes.

Construction of a special viewing platform approximately half way between the two bridges is recommended. This should be sited on a spot providing good opportunities for looking both upstream and downstream. Consideration should also be given to ensuring that enough cover by tall trees, etc. is available on the opposite bank to preclude undue amounts of glare reflecting from the water into viewers' eyes when the sun is low in the sky (given that early morning/late evening are generally the ideal times to spot a platypus).

Some examples of platforms used at existing platypus-viewing spots are illustrated below as possible models.

It is important that the river bank immediately below the platform should be heavily vegetated to mask the shape of the structure from a platypus perspective and to discourage informal paths or larger denuded areas of soil developing around the platform.

2) Signage

a) PCZ identification signage

Signs identifying the Platypus Conservation Zone (preferably featuring a specially designed PCZ logo) should be positioned around the zone at key locations – e.g. at the suspension bridge, Queens bridge, the viewing platform and three additional points along paths leading to or through the area. The signs

should also carry text and/or symbols identifying key management rules (e.g. dogs on leash only, no swimming for dogs, pick up litter, etc.).

b) Viewing platform area

Appropriate signage should be located at the viewing platform, both to clearly establish the purpose of the structure and to assist visitors in platypus spotting. This should consist of low panels at the front of the structure, positioned so that they do not interrupt the view of the river.

Each panel should cover only one or two topics to avoid a “clutter” of messages. Key topics should include:

- Hints on spotting platypus and water-rats
- Status of platypus and water-rats in Queanbeyan
- Platypus basic facts
- Water-rat basic facts
- Key conservation messages (especially regarding litter and inappropriate angling practices)

c) Suspension bridge

Additional signage relating to platypus spotting and/or conservation should be positioned at one end of the bridge.

d) Other signage

Although not strictly within the PCZ area, signs should be prepared at the same timespecifically relating to “platypus-friendly” fishing techniques to be displayed on the banks of the river in the section between Queens bridge and the main weir and at the caravan park.

Some examples of signage used at existing platypus-viewing spots are illustrated below, together with comments concerning the merits of utilising existing “Platypus Country” signage, as opposed to creating a signage style specifically designed for Queanbeyan. (see “A Note on Signage Style”).

4) Habitat restoration

Efforts should be made to improve habitat conditions for platypus in the PCZ, whilst still recognizing that this is a prime community recreation area with high public usage.

Where possible, buffer strips of native shrubs should be re-established on at least one side of the river along the length of the PCZ. Overhanging vegetation will promote the establishment of platypus burrows and help to protect animals from predators and human disturbance.

This type of rehabilitation is particularly recommended for the eastern bank immediately downstream of the suspension bridge. This bank is steep and not really safe for public access. It currently lacks good vegetation cover, making it potentially vulnerable to erosion. A dense cover of low-growing plants would substantially improve platypus habitat quality at this site without interfering with views of the river from nearby residences.

Considerable scope also exists for planting additional riparian shrubs at the downstream end of the PCZ, especially near the children’s playground on the eastern bank and in selected spots between the path and river’s edge on the western bank.

5) Siting of circuit path

A formal circuit track should be constructed around the PCZ (particularly to direct visitors easily to the viewing-platform). This should be sited to keep people and predators away from re-planted areas (as above) and to eliminate the development of informal tracks close to the water's edge.

6) PCZ rules

Canine on-leash rules should be enforced within the PCZ. Likewise, dogs swimming in the PCZ section of the river should also be discouraged and ideally prohibited.

Use of enclosed yabby traps in public waters is already prohibited under NSW fishing regulations, but signage regarding this issue is still recommended to improve public awareness. Angling should be allowed to continue in the PCZ but kept under review (and banned if there is reason to believe that angling is generating an unacceptable risk to platypus and other wildlife, as indicated by the presence of unattended lines or abandoned lures, hooks or tangled line along the river or by repeated discoveries (twice or more in five years) of platypus or other birds or mammals that have been injured due to use of fishing line or hooks).

Consideration should also be given to providing “fishing-line disposal receptacles” (see illustration) at a number of points throughout the PCZ (as well as the weir pool and caravan park sections of the river).

The PCZ should also be a focus for community “clean up” days and similar environmental events and activities.



A NOTE ON SIGNAGE STYLE

In developing signage for the PCZ and related areas, there is a choice between developing an image unique to Queanbeyan or adopting the “Platypus Country” style already used by some places in NSW (notably Wyong/Central Coast and Wellington Shires).



The existing “Platypus Country” format will obviously be cheaper to adopt. It can also be argued that Queanbeyan’s reputation as a prime platypus-spotting area will benefit from piggy-backing onto a “brand” that may be increasingly recognisable to tourists.

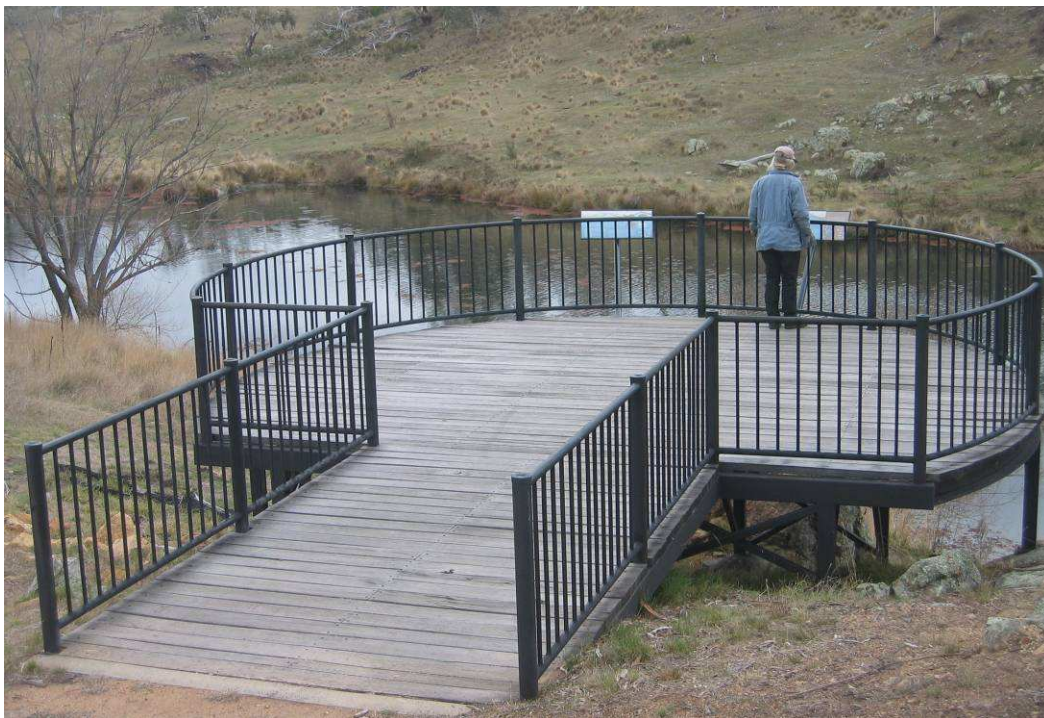
On the other hand, if Queanbeyan wants to develop its potential for platypus-based ecotourism, it may wish to stress a clear separate identity based on specifically designed signage and logo(s). In addition, it should be noted that the “Platypus Country” format utilises the logo of a commercial company (Australian Geographic). Consequently, QCC may prefer to develop an image not owned by a commercial third party.

EXAMPLES OF VIEWING PLATFORMS AND SIGNAGE

Bombala (NSW) Platypus Reserve



This generally is a very satisfactory facility, although more signage nearer the platform would be helpful to visitors while they are actually looking for platypus.





Signage quality is good, if somewhat limited in quantity. More hints on spotting platypus would be useful.

Kangaroo Island (SA) Platypus Ponds

An overbuilt structure, located too close to the water. Platypus sightings have apparently declined dramatically since this structure (which incorporates long stretches of noisy boardwalk next to the water) replaced informal viewing spots in the bush around the ponds.



A viewing "hide" is also used at this location and provides good opportunities for interpretation.



Burnie (Tasmania) "Fern Glade" Platypus Walk



Several elevated platforms are provided along the length of a riverside walk. These are similar in general design to the Bombala facility but slightly more rustic in terms of materials.

Signage is provided at spots along the trail, together with other interpretation (e.g. a stone sculpture of a platypus).



Skipton (Victoria) Stewart Park



A low-cost rustic-style platform that blends in well with the informal character of the park.



Signage is limited and somewhat cluttered.



Sunbury (Victoria) Emu Bottom Wetlands Reserve



A very low-key facility in a relatively little visited park. Not very suitable in design for a more highly urbanised area with greater visitation.

Signage is limited but quite stylish.



PLATYPUS FACT FILE

EVOLUTION, NAMING, DISTRIBUTION AND STATUS

History of discovery and naming

According to Aboriginal Dreamtime legend, the first platypus were born after an attractive young female duck mated with a lonely and persuasive water-rat. The duck's offspring had their mother's bill and webbed feet and their father's legs and handsome brown fur.

Early written records suggest that indigenous people were aware that the platypus was both egg-laying and venomous – facts that were only confirmed by European scientists after many decades of study. Traditional names for the species included "mallangong" and "tambreet" in New South Wales. Platypus were hunted for food in the water using long spears, but the meat appears not to have been highly prized.

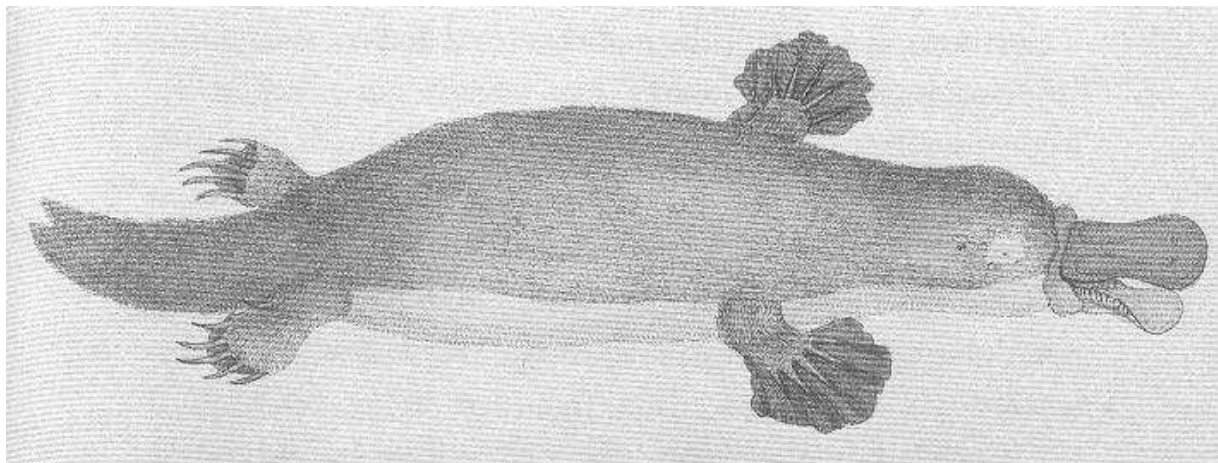
After the British colony in Australia was founded in 1788, the strange appearance of the platypus soon fascinated the new arrivals. Early colonists called the platypus a "water mole" or a "duckbill".

The platypus was first scientifically described by Dr George Shaw in Britain in 1799. His initial reaction to the first specimen was that it was an elaborate hoax. It was not uncommon at the time for exotic forgeries (such as "mermaids" made by joining the body of a monkey to that of a fish) to be brought back to Europe from far-flung parts of the world. Shaw was so convinced that the platypus specimen had been fabricated that he took a pair of scissors to the pelt, expecting to find stitches attaching the bill to the skin.



**The "FeeGee Mermaid",
exhibited by P.T. Barnum –
a fusion of monkey and fish
parts.**

**The illustration below made to
accompany Dr Shaw's first
description of the platypus.
Early illustrators had access only to
dead specimens and so struggled to
capture the qualities of a living
platypus.**



Dr Shaw named the species *Platypus anatinus*, from Greek and Latin words respectively meaning "flat-footed" and "duck-like". A German scientist named Blumenbach independently proposed a different scientific name in the following year, *Ornithorhynchus paradoxus*, with the first word meaning "bird-like snout" and the second meaning "puzzling".

It then transpired that the term *Platypus* had previously been used in 1793 to name a group of beetles. Accordingly, a different scientific name had to be formulated. This was achieved by combining the names suggested by Shaw and Blumenbach to produce *Ornithorhynchus anatinus*, which remains the official designation of the species today.

In the meantime, the abandoned scientific name "platypus" became the accepted common name for the species.

Given that the word "platypus" is derived from Greek, its plural form should (strictly speaking) be "platypodes" and definitely not platypi (which would be valid only if "platypus" were derived from Latin). However, given that "platypus" has now entered the English language as the common name for the species, the accepted plural is either "platypuses" or "platypus".

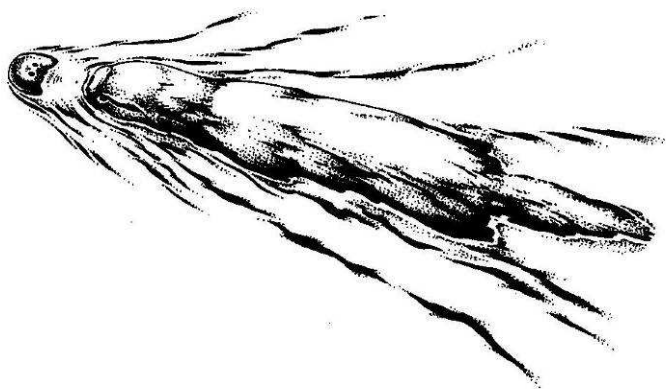
There is no well established term in the English language for a juvenile platypus. This presumably reflects fact that when a young platypus first emerges from its natal burrow it basically looks like a small adult. As juveniles are not normally seen by people at an earlier stage of development, there has never been a need to adopt a special term for a baby platypus. It has been suggested by staff working at Taronga Zoo in Sydney that "puggle" might be used. This word reputedly has had a reasonably long history of use to denote a baby echidna. However, as young platypus and echidnas look very different once they begin to grow up, the use of this term to denote a platypus is considered inappropriate by biologists who work with the species in the wild.

By the same token, there is no collective noun - equivalent to a school of fish or herd of cattle – which applies to the platypus. Platypus are fundamentally solitary in their habits, though more than one individual can sometimes be seen feeding at a given spot. Accordingly, there has never been a need to refer to these animals as a social unit.

Further reading:

Burrell, H. (1927). *The Platypus*. (Angus and Robertson: Sydney, reprinted in 1974 by Rigby: Adelaide).

Moyal, A. (2001). *Platypus - The Extraordinary Story of How a Curious Creature Baffled the World*. (Allen & Unwin: Crows Nest, NSW).



Related species and evolution

Just five modern species of monotreme (or egg-laying mammal) have been described:

- platypus (*Ornithorhynchus anatinus*)
- short-beaked echidna (*Tachyglossus aculeatus*) (illustrated at right)
- three species of long-beaked echidna (*Zaglossus bruijini*, *Z. bartoni* and *Z. attenboroughi*)



The platypus lives in Australia, long-beaked echidnas are found in New Guinea, and short-beaked echidnas occur in both Australia and New Guinea.

Based mainly on fossil remains found at Lightning Ridge (in New South Wales) and Dinosaur Cove and Flat Rocks (in Victoria), monotremes appear to have been a fairly diverse and important component of the Australian mammal fauna in the early Cretaceous period (roughly 110 million years ago). Living alongside these early monotremes were dinosaurs, turtles, lungfish and the now extinct ausktribosphenid mammals. These fossils date from a time when Australia was located far south of its current position and was joined to Antarctica as part of eastern Gondwana.

The only monotreme fossils found to date outside Australia belong to *Monotrematum suderamericanum*, described from teeth found in Patagonia (southern Argentina) that have been dated to about 62 million years ago. It is presumed that this discovery reflects the fact that monotremes dispersed to other parts of Gondwana after evolving in Australia.

The earliest known monotreme which unequivocally resembled what we think of as a platypus (based on finding a nearly complete, platypus-like bill) has been named *Obdurodon dicksoni* and dates from approximately 15-20 million years ago. *O. dicksoni* was a bit bigger than the modern platypus and had a larger bill and more powerful jaw muscles relative to the size of its head. In contrast to the current living form, adults also appear to have retained true teeth in the form of relatively thin-enamelled, six-rooted molars. The earliest known remains of the living species have been dated to around 100,000 years ago.

Investigating the evolutionary relationship between echidnas and the platypus has been hampered by the fact that the earliest known echidna fossils are only about 13 million years old. Based on patterns of genetic divergence, it has been hypothesized that the two groups began evolving independently as recently as 19-48 million years ago. Ironically, one of the most “primitive” physical features of monotremes – the typically reptilian design of the bones in the shoulder region – may explain why both the platypus and echidnas have survived so well. Although their limbs extend out from the body in a nearly horizontal plane and are primarily limited to rotational movements, the structure of their shoulder girdle also provides exceptional strength and ability when swimming (platypus) or digging (echidnas).

Further reading:

Flannery, T.F. and Groves, C.P. (1998). A revision of the genus *Zaglossus* (Monotremata, Tachyglossidae), with description of new species and subspecies. *Mammalia* 62: 367-396.

Musser, A.M. (1998). *Evolution, biogeography and palaeoecology of the Ornithorhynchidae*. *Australian Mammalogy* 20: 147-162.

Phillips, M.J., Bennett, T.H. and Lee, M.S.Y. (2009). *Molecules, morphology, and ecology indicate a recent, amphibious ancestry for echidnas*. *PNAS Early Edition*. www.pnas.org/cgi/doi/10.1073/pnas.0904649106.

Distribution and status

Platypus live only in Australia, inhabiting a wide range of flowing and still freshwater bodies from sea level up to an elevation of more than 1600 metres near the top of the Great Dividing Range. The species resides along the eastern and southeastern coast of mainland Australia from the Glenelg River catchment in western Victoria to about as far north as Cooktown in Queensland. In broad terms, populations still occur in about 80% of the river basins in Victoria, all of the east-flowing river systems and about 80% of the west-flowing systems in New South Wales, and around a third of reliably flowing river basins in Queensland. Predation by salt water crocodiles (*Crocodylus porosus*) and the severe flooding that often occurs along Australian tropical rivers in the wet season may both potentially contribute to the platypus's northern distributional limit.



Platypus distribution (shaded area)

Platypus are widely distributed in Tasmania, occupying lakes, ponds and glacial tarns as well as rivers and streams. The species also occurs in the rivers of King Island, which has been isolated from Victoria and Tasmania by the waters of Bass Strait for 10,000 or more years.

Only a few platypus specimens were ever collected in South Australia. Most originated along the Murray River (to as far downstream as Lake Alexandrina), although some were obtained along the Torrens and Onkaparinga Rivers before 1900. It is generally accepted that platypus no longer occur in the wild on the South Australian mainland, although vagrants moving downstream along the Murray River may occasionally enter the state. An introduced population is found near the South Australian mainland on Kangaroo Island, where animals were released in Flinders Chase National Park between 1928 and 1946. The absence of platypus populations to the north and west of South Australia undoubtedly reflects the rarity of reliable surface water in these areas.

The IUCN lists the conservation status of the platypus as of "least concern" and the Australian commonwealth and relevant state governments do not consider the species to be threatened (apart from South Australia, where it is listed as endangered). Nonetheless, there is ample evidence that platypus populations have declined precipitously in many parts of their range.

Factors contributing to the platypus's vulnerability to predicted longer-term patterns of climate change include the animals' complete dependence on adequate surface water for survival, their characteristically low population density and low reproductive rate, and the fact that female platypus are likely to be out-competed for food by larger (and more aggressive) males and therefore suffer disproportionately high mortality rates when surface water is severely limited.

Further reading:

Grant, T.R. (1998). *The historical and current distribution of the platypus, Ornithorhynchus anatinus, in Australia*. Pp. 232-254 in *Platypus and Echidnas* (edited by M.L. Augee). The Royal Zoological Society of NSW, Sydney.

APPEARANCE AND PHYSICAL ADAPTATIONS

Size and appearance

Like many other animals, platypus living at the warm end of their range in Queensland are generally somewhat smaller than those found at the cold end of their range in Victoria and Tasmania. The largest platypus recorded to date (in Tasmania) was a male weighing 3.0 kilograms and measuring 0.6 metres in length. On the mainland, adult males typically weigh 1.2-2.4 kilograms and are on average 0.5 metres long, whereas adult females typically weigh 0.7-1.6 kilograms and are on average 0.4 metres long.



The platypus's general appearance is quite distinctive, combining a streamlined, furry body with a broad, paddle-shaped tail, four short legs, and a superficially ducklike bill. To help reduce drag in the water, the male's testes and penis are normally held within the body. A platypus also lacks ear flaps (or pinnae): the ear and eye are both located in a muscular groove placed at the side of the head, which automatically pinches shut when an animal dives to protect the eye and ear underwater.



The platypus bill is supported by a framework of bone (left).

Note the corrugations along the inside edge of the bill (right) which presumably help a platypus to strain out water before swallowing food.



The platypus's body is covered by dense fur apart from its bill, feet and tail. The bill is covered by smooth skin with a soft, suede-like texture and (unlike a duck's bill) is quite pliable and fleshy around the edges. The upper surface of the tail is covered by coarse hairs which can stand up to the wear and tear involved in using the tail to help push aside and tamp down soil when a platypus digs or remodels a burrow. In contrast, the tail's lower surface is covered by short, fine hairs which are replaced each year when an animal moults but then wear away as the tail is dragged over stones and gravel, leaving the tail mostly bald below.

Across their entire range, platypus are dark brown above (except for a small patch of light-coloured fur located next to each eye) and creamy white below (sometimes tinged rusty-red). When the platypus's eyes are closed underwater, the light-coloured patches give the appearance of eyes remaining open, presumably fooling predators into being less likely to attack.



The upper surface of the bill is uniformly dark grey, with two nostrils located near the tip. The bill's lower surface can either be uniformly pigmented (**below left**) or quite mottled (**below right**).



The platypus's front foot is furnished with a broad expanse of skin which extends past the front claws to form a large and efficient paddle (**below left**). The webbing folds under the foot when out of the water, making it easier for a platypus to walk and use the sturdy front claws to dig burrows. The hind feet are used to help change direction and maintain balance in the water. In addition, they are equipped with sharp, curved claws used to groom the fur (**below right**).



Further reading:

Connolly, J.H. and Obendorf, D.L. (1998). *Distribution, captures and physical characteristics of the platypus (Ornithorhynchus anatinus) in Tasmania. Australian Mammalogy* 20: 231-237.

Grant, T.R. and Temple-Smith, P.D. (1983). *Size, seasonal weight change and growth in platypuses, Ornithorhynchus anatinus (Monotremata: Ornithorhynchidae), from rivers and lakes of New South Wales. Australian Mammalogy* 6: 51-60.

Sensory systems

Vision. The platypus's eye is small (6 millimetres in diameter) and equipped with a round pupil. The internal structure of the eye is typically mammalian in most respects but includes some reptilian features, such as the presence of double (as opposed to single) retinal cone cells used to perceive colour. The lens resembles those found in otters and sea lions, in being fairly flat at the front and much more curved at the back. This shape reduces the eye's ability to see fine detail, but improves underwater vision.



The eyes of a platypus are located quite high on its head, making it easier for the animal to scan for predators while floating on the water surface.

Interestingly, the platypus rarely uses sight when submerged - its eyes normally close automatically as soon as it dives. One possible explanation is that the platypus's ancestors relied on underwater vision more extensively than the modern species does.

Hearing. Platypus ears resemble those of other mammals in most respects but do have a few primitive features, such as the fact that the ear region is encased in cartilage rather than bone. The platypus ear is most sensitive to sound frequencies around 4 kilohertz (exactly the same as in humans) but can hear frequencies as high as 15 kilohertz.

Smell and taste. Aquatic mammals typically don't rely much on smell to find food or detect predators, as chemical cues tend to be washed away by water. In the case of the platypus, only about half as many genes are linked to standard odour detection as compared to most land-based mammals. However, scientists have been intrigued to learn that the platypus has an exceptionally large number of genes coding for specialised smell receptors in the vomeronasal (or Jacobson's) organ – paired pouch-like structures located in the roof of the mouth. Vomeronasal organs are found in both reptiles and mammals and are mainly important in social communication – detecting odours produced by other individuals of the same species. Accordingly, these receptors are likely to be used by a platypus to track chemical signs left to mark territorial boundaries or advertise reproductive status, though it's possible they may also help the platypus find its prey underwater.

The platypus has two grooves at the back of the tongue which are lined with sensory papillae (tiny projections) which are believed to be used to taste food.

Bill sensory receptors. The skin of a platypus bill holds tens of thousands of specialised sensory structures providing information needed to navigate underwater and capture prey. Receptors known as “push rods” are sensitive to touch or pressure, either as an outcome of solid objects contacting the skin or water movement. Nerves are activated when the tip of a push rod receptor is displaced by as little as 20 microns (0.00002 metres), which means a platypus can detect the movements of edible invertebrates such as freshwater shrimp or crayfish at a distance of 15-20 centimetres, simply by sensing the associated movement of water.

The bill surface is also thickly dotted with acutely sensitive electroreceptors (“sensory mucous glands”), which respond to the tiny amount of electricity generated when the muscles of aquatic invertebrates contract. Because electricity moves so rapidly through water, the tail flick of a shrimp will be recorded a fraction of an instant earlier by bill electroreceptors as compared to push rods, providing a way for a platypus to judge the distance to a prey item.



Further reading:

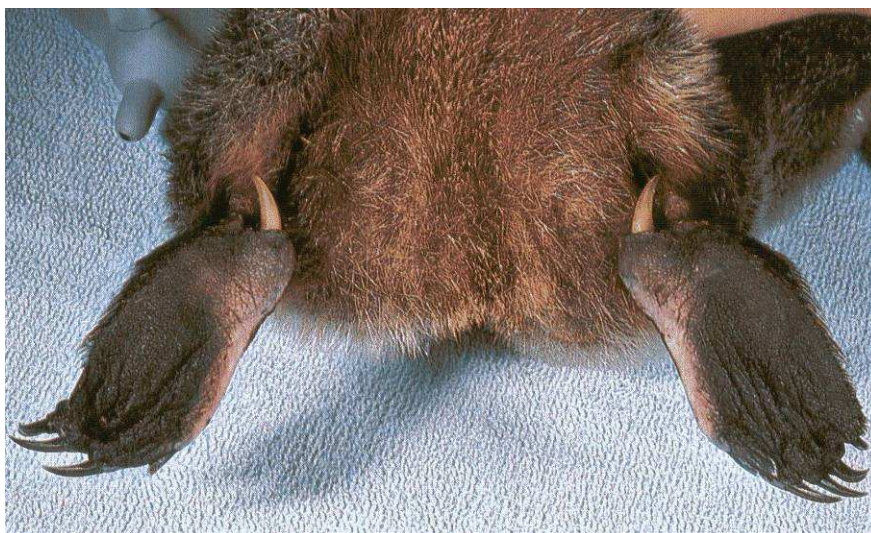
Pettigrew, J.D., Manger, P.R. and Fine, S.L.B. (1998). *The sensory world of the platypus. Philosophical Transactions of the Royal Society of London, Biological Sciences* 353: 199-1210.

Proske, U., Gregory, J.E. and Iggo, A. (1998). *Sensory receptors in monotremes. Philosophical Transactions of the Royal Society of London, Biological Sciences* 353: 1187-1198.

Scheich, H., Langner, G., Tidemann, C., Coles, R.B. and Guppy, A. (1986). *Electroreception and electrolocation in platypus. Nature* 319: 401-402.

Venom and spurs

Spurs and venom. The male platypus has a conspicuous spur (similar in size and shape to a dog's canine tooth) located on the inner hind ankles (**right**). Adult spurs are typically 12-18 millimetres long and made of keratin, the structural protein found in feathers and human fingernails. The spur is connected to a venom-secreting gland, known as the crural gland. Platypus venom is first produced when a male



becomes mature, and more venom is secreted during the spring breeding season than at other times of year. Accordingly, it is believed that platypus spurs and venom have mainly evolved to help adult males compete for mates.

Platypus venom is a clear, slightly sticky fluid. It contains at least 19 different compounds which appear to have evolved quite independently from those found in snake venoms. Platypus venom is not life-threatening to humans, but can cause severe localised swelling and excruciating pain which gradually

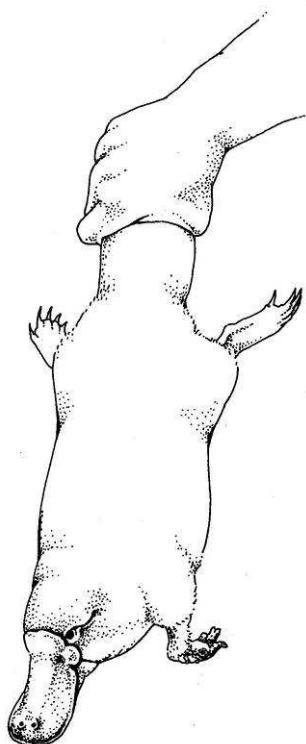


abates over a period of a few weeks. At its worst, the pain is not very effectively relieved by standard analgesics such as morphine and is only made worse by application of ice packs. However, it can be treated successfully with drugs such as bupivacaine, which act by blocking nerve transmission.

Venom leaking from the tip of an adult platypus spur.

Platypus spurs are normally held in a relaxed position, folded back against the inner ankle. Particularly during the breeding season, a spurring response will be initiated if the male is touched or stroked on its abdomen in the area between the hind legs. The hind feet are rapidly rotated outwards and upwards, pulling each spur erect and locking it into position against the lower limb bones. Both spurs are then jabbed inwards with great force, impaling any object in their path from two directions.

Although platypus are not particularly aggressive animals, great care should be taken whenever picking up either an adult male or an individual of unknown age and sex. In particular, such an animal should NEVER be supported from below. Instead, grasp the animal firmly by the END half of the tail (which cannot be reached by the spurs) before lifting it up and transferring it to a cloth bag, lidded box or other secure container.



When holding a platypus by the tail, it should be easy to determine if the animal is a male (based on the presence of conspicuous spurs on the ankles).

The appearance of male spurs changes with age. In the case of young juveniles, spurs are relatively short and stubby and covered in a sheath of whitish keratin. This covering gradually wears away, exposing the true spur which continues to grow. The spurs of subadult (second year) males can normally be distinguished from older individuals by the presence of a pink collar of skin which initially extends about one-third up the length of the spur. The collar skin gradually regresses and is very much reduced by the time that males mature at the age of two years.



Examples of a juvenile male spur (left) and subadult male spur (right).



Adult females of any age are easily told apart from males because they do not possess true spurs. However, juvenile females do have a tiny pointed brown or whitish “spur” – typically 1-2 millimetres in length – on their hind ankles. This structure generally disappears within about 8-10 months of a young female’s emergence from a nursery burrow, leaving behind a small pit in the skin.



Juvenile females have a tiny false spur (left, circled) which is lost by the time a female is one year old (right).



Further reading:

Fenner, P.J., Williamson, J.A. and Myers, D. (1992). *Platypus envenomation – a painful learning experience. The Medical Journal of Australia* 157: 829-832.

Koh, J.M.S., Bansal, P.S., Torres, A.M. and Kuchel, P.W. (2009). *Platypus venom: source of novel compounds. Australian Journal of Zoology* 57: 203-210.

Body temperature and torpor

The platypus normally maintains a body temperature close to 32°C. This is a bit lower than the body temperature of most other mammals – for example, the temperature of a healthy human is usually about 37°C. The platypus's relatively low body temperature is believed to be an adaptation to conserve energy, particularly when an animal is swimming in cold water.

To further reduce heat loss, platypus fur is made up of two layers: an extremely dense undercoat (including up to 900 individual hairs per square millimetre of skin surface) and coarser overlying guard hairs. These layers work together to trap air next to the platypus's skin when an animal enters the water, so most of the body surface actually remains dry. The combined insulation value of the fur and air layer has been estimated to be similar to a three millimetre layer of neoprene wetsuit material.



Secondly, the platypus has a special network of small intertwined veins and arteries in the pelvic region (known to scientists as a rete mirabile or literally “miraculous network”). This network serves as a countercurrent heat exchange system: cooled blood returning to the heart from the animal's legs and tail absorbs some warmth from blood being pumped from the chest, reducing the overall loss of body heat to the environment.

One disadvantage of being so well adapted to surviving cold conditions is that the platypus has a propensity to overheat: in captivity, animals become “noticeably lethargic” when the water in display tanks exceeds 29°C, and a platypus has reportedly lost consciousness after being exposed to an air temperature of 35°C for 17 minutes. Overheating is not normally a problem for platypus in the wild, as they prefer to spend their time either immersed in substantial bodies of water or resting in burrows, where average air temperatures typically do not exceed 18-20°C even in summer. However, it does mean that platypus are likely to overheat badly if they try to travel long distances across land in summer, for example to find new feeding sites during a drought.

Observations in both captivity and along a small stream in Victoria suggest that platypus may periodically enter a state of torpor in which the animals allow their body temperature to drop, remaining inactive for up to about six days. This behaviour has only been recorded in the colder months of the year (late May to early September). Interestingly, no records of inactivity have been recorded in the course of platypus radio-tracking studies undertaken in winter along two rivers in New South Wales or a sub-alpine lake in Tasmania, suggesting that low ambient temperatures are necessary but not sufficient to trigger torpid behaviour in this species.

Further reading:

Grant, T.R. and Dawson, T.J. (1978). *Temperature regulation in the platypus, Ornithorhynchus anatinus: maintenance of body temperature in air and water. Physiological Zoology* 51: 1-6.

Grant, T.R. and Dawson, T.J. (1978). *Temperature regulation in the platypus, Ornithorhynchus anatinus: production and loss of metabolic heat in air and water. Physiological Zoology* 51: 315-332.

Grigg, G., Beard, L., Grant, T. and Augee, M. (1992). *Body temperature and diurnal activity patterns in the platypus (Ornithorhynchus anatinus) during winter. Australian Journal of Zoology* 40: 135-142.

ECOLOGY, BEHAVIOUR AND GENETICS

Diet and foraging

Platypus feed only in the water. The animals mainly find their invertebrate prey by searching along shallow riffles, gleaning items from submerged logs and branches, digging under banks or diving repeatedly to the bottom of pools.

Platypus foraging behaviour in a pool begins with an animal doing a neat, quiet duck dive. The animal swims to the bottom of the channel and uses its bill to detect and seize prey. Rather than waste time chewing its food underwater, the platypus temporarily stores prey items in cheek pouches located at the back of the jaw. It returns to the surface when its oxygen supply runs low (usually within 30-60 seconds of the time it dived, though dives of up to 138 seconds have been recorded) and then typically spends about 10-20 seconds masticating and swallowing food before again diving. The use of dataloggers has confirmed that platypus mainly but by no means exclusively feed at night, with around 25% of animals tracked along a small Victorian stream and 40% of animals tracked in a Tasmanian lake observed to forage frequently during daylight hours.



A typical platypus “duck-dive” (left) – platypus are naturally buoyant and have to force themselves down into the water.

A platypus chews its food while floating on the surface (right).



Platypus typically have a varied diet dominated by insects (especially caddis fly larvae, but also larval and adult water beetles, water bugs, and larval mayflies, damselflies, dragonflies, dobsonflies, midges, crane flies and blackflies). They also dine on freshwater shrimps, snails, “pea shell” mussels, seed-shrimps (or ostracods), water mites and worms. Burrowing crayfish have been found to be an important part of the platypus diet at Lake Lea in Tasmania, and trout eggs are known to be consumed by animals occupying the Thredbo River in New South Wales. After comparing the invertebrates found in different aquatic habitats with those identified in platypus cheek pouches, a researcher working in the Kangaroo Valley of New South Wales has concluded that platypus are particularly partial to the types of prey occupying edge habitats (defined as including pool margins and backwaters, the space below overhanging banks and among submerged vegetation and organic detritus), followed by those in pools and lastly by those associated with riffles.

The platypus's ability to prey on sizable fish or other vertebrates is restricted by its lack of true teeth. Remains of a small frog (which may have been consumed as carrion) have been found in one platypus cheek pouch sample from the Shoalhaven River in New South Wales. A young platypus is equipped with true molars located at the back of the jaw, which fall out about the time that a juvenile first enters the water and begins to eat solid prey. The teeth are replaced by rough grinding pads which grow continuously to offset natural wear.

Because the platypus is a relatively small, warm-blooded animal, it needs substantial amounts of food to serve as fuel. Studies in captivity have shown that adult males require around 15-28% of their body mass in food each day to maintain good physical condition, with more food consumed in winter and spring than at other times of year. Similarly, the average daily food intake of animals occupying a Tasmanian lake has been estimated to be 19% of body mass. Not surprisingly, the amount of food eaten by lactating females increases markedly as their offspring grow. For example, daily food consumption by a mother of twins in captivity rose to around 80% of her body mass just before the young first emerged from the nesting burrow - roughly three times her daily food consumption in the months before she mated.

Further reading:

Bethge, P., Munks, S.A., Nicol, S. and Otley, H. (2000). The use of dataloggers to determine behavioural activity in the platypus. Australian Mammalogy 21: 262-263.

*Bethge, P., Munks, S., Otley, H. and Nicol, S. (2003). Diving behaviour, dive cycles and aerobic dive limit in the platypus *Ornithorhynchus anatinus*. Comparative Biochemistry and Physiology A 136: 799-809.*

*Faragher, R.A., Grant, T.R. and Carrick, F.N. (1979). Food of the platypus (*Ornithorhynchus anatinus*) with notes on the food of brown trout (*Salmo trutta*) in the Shoalhaven River, N.S.W. Australian Journal of Ecology 4: 171-179.*

*Holland, N. and Jackson, S.M. (2002). Reproductive behaviour and food consumption associated with the captive breeding of platypus (*Ornithorhynchus anatinus*). Journal of Zoology (London) 256: 279-288.*

McLachlan-Troup, T.A., Dickman, C.R. and Grant, T.R. (2009). Diet and dietary selectivity of the platypus in relation to season, sex and macroinvertebrate assemblages. Journal of Zoology 2009: 1-10.

Munks, S.A., Otley, H.M., Bethge, P. and Jackson, J. (2000). Reproduction, diet and daily energy expenditure of the platypus in a sub-alpine Tasmanian lake. Australian Mammalogy 21: 260-261.

Spatial organisation and movements

Based on radio-tracking studies, the home ranges of neighbouring female platypus occupying creeks in the Yarra River catchment near Melbourne often overlap by about half their total length. Adult males occupy areas which are not necessarily shared with other males but typically overlap the home ranges of two or more adult females. In cases where male home ranges do overlap, the males appear to try to avoid each other when active. The home ranges of adult males tracked for a few weeks in these creek habitats typically include 1-7 kilometres of channel, as compared to 1-4 kilometres for adult females. Males and females both visit roughly one-quarter to three-quarters of their total home range in most foraging periods. However, an adult male has been recorded to travel up to 10.4 kilometres (including backtracking) in a single overnight period, whereas the longest corresponding distance for an adult female is 4.0 kilometres.

Along the Goulburn River (where it presumably is much harder for an adult male to exclude other males from a given area, due to the greater width and depth of the channel), male home ranges overlap throughout the year, but less overlap is apparent during the breeding season than at other times of year. Male home ranges have been found to vary in length from 0.55-2.8 kilometres, corresponding to 2.45-15.45 hectares of foraging area. However, animals do not utilise all parts of their home range equally, with an intensively used core area typically comprising 30% of the total home range area. Including backtracking, animals were recorded to travel up to 4.1 kilometres in a given night.

Longer movements by platypus have been documented, including a radio-tagged adult male that travelled more than 15 kilometres (between two creeks in the Yarra River catchment) on at least two occasions within a period of 10 weeks. Based on mark-recapture studies, a young male is known to have moved about 40 kilometres in the Yarra system over a period of 18 months or less (from Andersons Creek to Steels Creek), and a young male travelled nearly 48 kilometres in the Wimmera River catchment over a period of 7 months or less (from the Wimmera River to Mount Cole Creek).

Due to their mobility, platypus may occasionally be seen in virtually any part of a river system where they occur. With respect to conservation management, this mobility has three important consequences:

- Suitable vacant habitats are predicted to be occupied quite promptly by platypus through natural colonisation (particularly if the new habitats are located reasonably close to areas already supporting the species).
- Stretches of river or stream which do not support a resident platypus population may still constitute important habitat for the species, by providing corridors along which breeding males and dispersing juveniles can travel.
- It is essential that manmade structures (weirs, culverts, irrigation control gates, etc.) placed along natural water bodies or manmade channels that are accessible to platypus should be built in a manner which facilitates safe passage by the animals.

Further reading:

Gardner, J.L. and Serena, M. (1995). *Spatial organisation and movement patterns of adult male platypus, Ornithorhynchus anatinus (Monotremata: Ornithorhynchidae)*. *Australian Journal of Zoology* 43: 91-103.

Gust, N. and Handasyde, K. (1995). *Seasonal variation in the ranging behaviour of the platypus (Ornithorhynchus anatinus) on the Goulburn River, Victoria*. *Australian Journal of Zoology* 43: 193-208.

Serena, M. (1994). *Use of time and space by platypus (Ornithorhynchus anatinus: Monotremata) along a Victorian stream*. *Journal of Zoology (London)* 232: 117-131.

Reproduction and life history

The platypus is a monotreme, or egg-laying mammal. Males and females have a single physical opening (known as the cloaca) which is used both for reproduction and excretion.

Platypus have been observed mating in the wild in Victoria and New South Wales from early August to early November, with animals believed to breed a few weeks earlier in Queensland and a few weeks later in Tasmania. The animals do not appear to form lasting pair bonds: males probably court as many females as possible, and females rear their young without any assistance from their mates. Based on observations made in captivity, a female becomes receptive to males for a period of 4-6 days. Afterwards, she digs or renovates a nesting burrow and then spends 2-5 days collecting vegetation from

the water (leaves, grass, bark strips, etc.) to line the nest. It is believed that wet nesting material is required to help keep platypus eggs and newly hatched young from drying out.

A clutch of 1-3 whitish, leathery-shelled eggs (like those of lizards and snakes) is laid approximately 2-3 weeks after mating. The eggs are incubated underground for around 10 days, clasped between a female's curled-up tail and belly as she lies on her back or side. The eggs are about 15 millimetres in diameter, and the young are correspondingly small when they hatch (about 9 millimetres in length). Their exit from the egg is assisted by a prominent bump (or caruncle) at the end of the snout, an inwardly curving egg tooth and tiny claws on the front feet.



Platypus eggs (left) are similar to those of reptiles (Photo: David Doubilet, *National Geographic*,

April 2000).

Platypus milk oozes directly onto the belly from pores contained in two round patches of skin (note white patch at right).



After hatching, juveniles (there is no well-established special term for a baby platypus) develop in the nesting burrow for about 3-4 months before entering the water for the first time. Throughout this period, they are nourished only on milk. A female platypus does not have nipples. Instead, milk is secreted directly onto her belly fur from two round patches of skin. Platypus milk is thick and rich, containing on average about 39% solids (as compared to 12% solids in cow milk). The average fat content of platypus milk (22%) is about six times greater than that of cow milk, while its protein content (8%) is more than double the average value for cow milk.



The newly emerged juveniles are fully furred, well coordinated and about 80% of their adult length. They apparently are not taught to swim or how to feed by their mother, but have to learn by themselves through trial and error.

Males and females both become mature at the age of two years. However, some females may not produce young until they are four years old or more, with a long-term study carried out by Dr Tom Grant along the Shoalhaven River in New South Wales indicating that less than half of females breed on average in a given year (range = 18-80% over 27 years).

A juvenile soon after first emerging from its nesting burrow (left).

The juvenile mortality rate generally appears to be high, with only a small proportion of young platypus surviving to adulthood. However, it is not uncommon for adults to live for a decade or more. The oldest known platypus (a female) survived to the age of at least 21 years in the wild.

Further reading:

Grant, T.R., Griffiths, M. and Temple-Smith, P.D. (2004). *Breeding in a free-ranging population of platypuses, Ornithorhynchus anatinus, in the upper Shoalhaven River, New South Wales – a 27 year study. Proceedings of the Linnean Society of New South Wales* 125: 227-234.

Griffiths, M., Green, B., Leckie, R.M.C., Messer, M. and Newgrain, K.W. (1984). *Constituents of platypus and echidna milk, with particular reference to the fatty acid complement of the triglycerides. Australian Journal of Biological Sciences* 37: 323-329.

Hawkins, M. and Battaglia, A. (2009). *Breeding behaviour of the platypus (Ornithorhynchus anatinus) in captivity. Australian Journal of Zoology* 57: 283-293.

Social behaviour and communication

Although the home ranges of several platypus may overlap at any given spot, individuals (including mothers and their offspring) normally forage independently of each other. Males have been observed grappling vigorously in the water during the spring breeding season, presumably in order to work out who is dominant. In places where several platypus regularly feed within sight of each other (such as some lakes), it is not unusual for one animal to swim directly towards another during the breeding season, generally starting from a distance of 30-100 metres. The second animal sometimes responds by leaving the area (with or without the first animal in hot pursuit). On other occasions, two animals will swim side by side for a short distance or feed near each other for a few minutes before again moving apart.

In captivity, platypus courtship behaviour may be initiated by females as well as males. A pair will gently nuzzle each other's bill or face one another on the surface with bills nearly touching for up to ten minutes.



One animal will rub against the length of the other while gliding past, and a male will use his bill to grasp the tip of the female's tail and be towed behind her as she swims on or near the water surface, with the pair often travelling in a tight circle. Mating has only been recorded to occur in the water, for periods lasting from a few minutes up to nearly half an hour.

Platypus courtship behaviour in the wild.

When feeling threatened or annoyed, a platypus will voice its displeasure by emitting a querulous growl, similar to the sound made by a broody bantam hen disturbed on her nest. Olfactory cues may also assist communication: in the case of males, scent glands located at the base of the neck become particularly active during the breeding season, emitting a strong, musky odour. Captive males have also been observed producing a yellow, mucilaginous liquid from the cloaca after swimming to a stone or similar object. The liquid settles in a cloud over the object, presumably helping to mark the male's territory.

Further reading:

De-La-Warr, M. and Serena, M. (1999). Observations of platypus *Ornithorhynchus anatinus* mating behaviour. *The Victorian Naturalist* 116: 172-174.

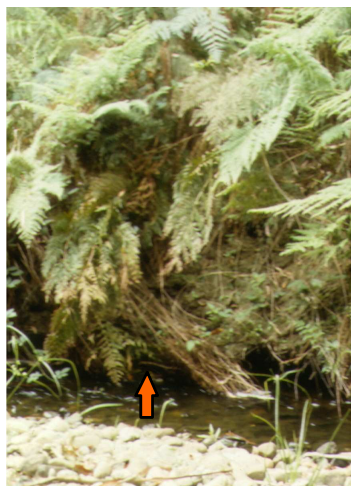
Easton, L., Williams, G. and Serena, M. (2008). Monthly variation in observed activity of the platypus *Ornithorhynchus anatinus*. *The Victorian Naturalist* 125: 104-109.

Strahan, R. and Thomas, D.E. (1975). Courtship of the platypus, *Ornithorhynchus anatinus*. *Australian Zoologist* 18: 165-178.

Burrows

Platypus resting sites most often consist of burrows located in the consolidated earthen banks of a river, creek or lake. However, the animals have also occasionally been recorded sleeping in a hollow log or within a large pile of twigs and branches emerging from the water, in a natural cave, or (in Tasmania) in a burrow constructed within dense vegetation such as sedge tussocks.

“Nesting” burrows provide shelter for a mother and her offspring for several months, from the time that eggs are laid to the time that young become independent. These burrows are typically 3-6 metres in length (measured in a straight line from the entrance to the nesting chamber), though they can be much longer. The entrance to a nesting burrow is roughly oval in cross-section and just large enough to allow an adult platypus to enter. It also tends to be elevated well above the water along a reasonably steep bank, with its height probably helping to reduce the risk of inundation after storms. Whenever she enters or exits the burrow, a mother of young juveniles blocks the entry tunnel at 2-9 points with compacted soil plugs (or “pugs”), each measuring about 30 centimetres in length. The tunnel often changes direction immediately after a pug, suggesting that its main role is to fool predators into thinking they have come to the end of the burrow.



Dense vegetation on stream banks provides excellent cover for platypus burrows (entrances marked with red arrows) (above left and centre). A burrow entrance, exposed after a drop in water level (above right).

“Camping” burrows mainly provide a safe place for an adult or subadult to sleep. They are shorter than nesting burrows, typically measuring 1-4 metres in length. Based on radio-tracking studies, some camping burrow entrances are located underwater, with the rest typically well hidden by thick vegetation or beneath a stably undercut bank or overhanging tree roots. Besides helping to camouflage burrow

entrances, such sites provide a relatively secure, hidden route for a platypus to approach or leave a burrow without being seen.

An adult platypus will normally occupy several different camping burrows within a period of a few weeks, with a given burrow sometimes used by different animals at the same or different times. For example, a study carried out in Victoria found that eight radio-tagged platypus each occupied between two and eight burrows over periods of 8-58 days. One burrow was occupied by a subadult male and an adult male for four days in early January (i.e. well outside of the breeding season), and a second burrow was occupied by two grown females for five days in early February. The burrow occupied by the two males was also subsequently occupied by an adult female, more than a year after it was used by the males.

Further reading:

Grant, T.R., Grigg, G.C., Beard, L.A. and Augee, M.L. (1992). *Movements and burrow use by platypuses, Ornithorhynchus anatinus, in the Thredbo River, New South Wales. Pp. 263-267 in Platypus and Echidnas (edited by M.L. Augee). The Royal Zoological Society of NSW, Sydney.*

Otley, H.M., Munks, S.A. and Hindell, M.A. (2000). *Activity patterns, movements and burrows of platypuses (Ornithorhynchus anatinus) in a sub-alpine Tasmanian lake. Australian Journal of Zoology 48: 701-713.*

Serena, M., Thomas, J.L., Williams, G.A. and Officer, R.C.E. (1998). *Use of stream and river habitats by the platypus, Ornithorhynchus anatinus, in an urban fringe environment. Australian Journal of Zoology 46: 267-282.*

Genetics

Platypus genes are packaged in a set of 52 chromosomes, twelve of which are relatively large and the rest quite small. Like other mammals, the sex of a platypus is determined by inheriting X and Y chromosomes, with females having five pairs of X chromosomes and males having five X chromosomes and five Y chromosomes. However, much of the genetic information contained in platypus sex chromosomes appears to be different from that contained in the sex chromosomes of marsupials and placental mammals, with some evidence suggesting that a gene involved in determining the sex of birds may also be involved in determining the sex of a platypus.

The platypus genome has been estimated to include approximately 18,500 protein-coding genes, which is at the lower end of the range of estimates for the number of human genes. A map of the platypus genome was published in 2008, based on research carried out by more than 100 scientists based at 32 universities and research institutes located in nine different countries. It showed that most platypus genes (82%) also occur in other vertebrate animals such as mice, dogs, chickens, humans and opossums (a North American marsupial). These genes presumably are involved in basic biological functions that haven't altered for hundred of millions of years. The remaining 18% include genes that have developed since the platypus lineage began evolving independently of other modern vertebrates, along with genes that have been retained by the platypus but lost by other species over evolutionary time.

An analysis of microsatellite DNA sampled in two neighbouring river basins in New South Wales (Shoalhaven and Hawkesbury-Nepean) concluded that the two systems were not very divergent, suggesting that platypus move reasonably frequently between them. In another study, Tasmanian platypus were found to be genetically less variable than animals found on the Australian mainland, with

even less variability recorded in the small and very isolated platypus population occupying King Island in Bass Strait.

Further reading:

Akiyama, S. (2000). *Molecular ecology of the platypus in Tasmania. Australian Mammalogy* 21: 263.

Kolomyjec, S.H., Chong, J.Y.T., Blair, D., Gongora, J., Grant, T.R., Johnson, C.N. and Moran, C. (2009). *Population genetics of the platypus (Ornithorhynchus anatinus); a fine-scale look at adjacent river systems. Australian Journal of Zoology* 57: 225-234.

Warren, W.C. et al. (2008). *Genome analysis of the platypus reveals unique signatures of evolution. Nature* 453: 175-184.



Platypus death highlights need for anglers to show care

13 October 2011

Queanbeyan City Council's Group Manager of Sustainability and Better Living, Mr Mike Thompson said the death of a female platypus in the Queanbeyan River today highlights the need for anglers to take care when fishing in local waterways.

"The platypus died as a result of fishing line being wrapped around its neck," Mr Thompson said.

"Discarded fishing line is a major threat to platypus as they do not use their eyes in the water but the sensors on their bills for foraging. Line tends to wrap around their bills or neck which stops them from eating and affects their breathing. The line may also catch on snags or other objects, tightening around its body and either trapping the animal underwater where it drowns or causing it to die from exhaustion.

"People who fish along the river need to be diligent in recovering their snagged line and avoid using unattended set lines and nets.

"The discovery of a dead platypus is distressing to those involved and to the general community who value the fact that there are platypus in our River and want to see them continue to thrive and live in the area."

The death of this platypus comes as Council considers its new Draft Plan of Management for the Queanbeyan River and Platypus Awareness and Conservation Strategy.

"The Strategy identifies many things that the community can do to improve the habitat and survival chances for platypus in our urban environment," Mr Thompson said.

"The Draft Report will be considered by Council in the coming weeks and if endorsed will be placed on public exhibition for comment.

"Queanbeyan is fortunate to have a partnership with the Australian Platypus Conservancy (APC) and ACT Waterwatch who both have official monitoring platypus sighting programs. Residents are encouraged to report sighting to either of these organisations or to Council itself."

Dr Melody Serena of the APC said, "unfortunately, we know of many cases where a platypus has died as a result of becoming entangled in fishing line. This death is particularly tragic given that the animal was a female and any babies produced by her this spring are now doomed to die of starvation.

"To avoid these sorts of incidents, it's really important that anglers make it their habit to retrieve any lengths of line that get snagged in the water. Also, if they do happen to see a platypus while angling, the best thing to do is to stop fishing for a few minutes until the platypus has moved away so it doesn't get accidentally hooked."

For further information contact Council's Sustainability and Better Living Group on 6285 6574.

ENDS

For more information contact
Ricky Tozer, Communications Coordinator on 6285 6577

AUSTRALIAN WATER-RAT FACT FILE



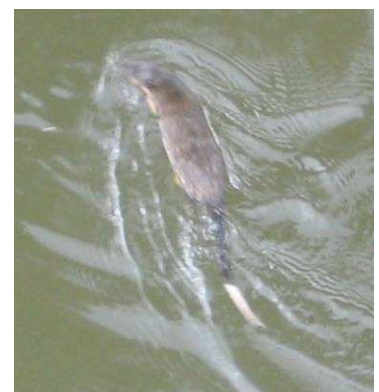
INTRODUCTION

The rodents that Australians are most likely to come in contact with are recently introduced species that are officially classified as pests: house mice, black rats and brown rats. However, Australia also supports a diverse array of native rodents that have been a part of the local landscape for at least half a million years and in some cases much longer.

The largest of these is the Australian water-rat (also known as rakali), a very attractive animal weighing up to 1.3 kilograms – as big as a medium-sized platypus. The water-rat's ancestors are believed to have arrived in Australia around 5-10 million years, after swimming (or possibly rafting) from New Guinea.

The Australian water-rat is an aquatic predator which resembles a small otter in many ways:

- Muzzle is blunt and furnished with a dense set of whiskers (**below left**)
- Hind feet are broad, partly webbed and paddle-like (**below centre**)
- Tail is well-furred and thick to help serve as a rudder when swimming (**below right**)
- Body is elongated and streamlined
- Ears are small and can be folded flat against the head for a streamlined profile
- Fur is soft and lustrous, drying quickly and helping to keep the animal warm in the water



EVOLUTION, NAMING, DISTRIBUTION AND STATUS

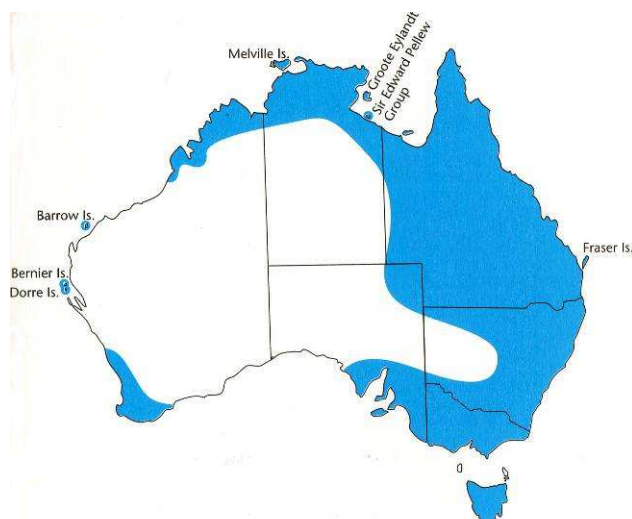
Naming

The scientific name of the species (*Hydromys chrysogaster*) translates as “golden-bellied water mouse”. Early European settlers sometimes called this animal a “beaver rat”, even though it is actually much more like an otter than a beaver in its behaviour.

In the early 1990s the Australian federal government proposed changing the common name of the Australian water-rat to “rakali”, which is one of the aboriginal terms for the animal. Although rakali has gained some public acceptance as the common name for *Hydromys chrysogaster*, these animals are still more widely known as “water-rats”.

Distribution and status

Australian water-rats occupy a wide variety of natural and manmade freshwater habitats, including swamps, ponds, lakes, rivers, creeks and irrigation channels. They also inhabit brackish estuaries and sheltered ocean beaches. Water-rats are widely distributed on both the mainland and Tasmania and also occur on many offshore islands.



Distribution of *Hydromys chrysogaster* in Australia
(source: Mammals of Australia)

Although very little is known about the current status of water-rats in most parts of their range, capture rates in most areas tend to be quite low. In part, this reflects the fact that water-rats are highly intelligent animals that are naturally wary of entering metal cage traps and also spend a large proportion of their time feeding in the water rather than on land. Water-rats are also very good at escaping from nylon mesh survey nets set in the water, using their sharp teeth to snip holes through the netting and escape.

In addition, water-rats are relatively aggressive animals that do their best to defend a territory through scent-marking and aggressive behaviour towards other individuals. In turn, this will tend to ensure that relatively low numbers of adult water-rats occur in most habitats.

Anecdotal evidence also suggest that water-rat numbers have declined in many places in southeastern Australia particularly since the mid-1990s, probably due to the combined impacts of drought and habitat degradation. More work is needed to map where water-rats occur and determine how the species' distribution may have changed in recent decades. In turn, this information will provide a factual basis for longer-term population monitoring.

APPEARANCE AND PHYSICAL ADAPTATIONS

Size and appearance

Adult water-rats measure up to 35 cm in length from their nose to rump, with a slightly shorter tail. Adult males typically weigh 0.8 kilograms (up to 1.3 kg) and adult females typically weigh 0.6 kilograms (up to 1.0 kg).

Depending on location, water-rats can vary considerably in colour. The head and back may be nearly black (with golden-yellow belly fur) or some shade of brown or grey (with fawn- to cream-coloured belly fur). However, apart from occasional individuals that have lost the end of their tail through fighting, water-rats are characterised by a distinctive white tip to the tail across their entire geographic range.



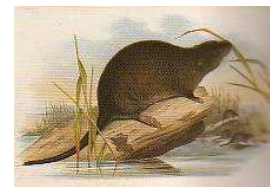
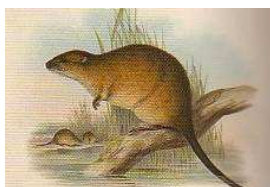
The white tip to the tail is the most obvious identifying feature of the water-rat, whether the animal is in the water or on land.

Water-rat fur is moulted twice a year, being coarser and denser in winter. As in the case of platypus fur, it consists of a dense, fine layer of underfur covered by coarser guard hairs. Although water-rat fur is reasonably waterproof, it is much less effective than platypus fur at keeping its owner warm – water-rats are unable to maintain their body temperature in water temperatures below 25°C and consequently need to exit cold water at regular intervals in order to warm up in a burrow or other sheltered site.

Related species and subspecies

Hydromys chrysogaster has no close relatives in Australia, although several other species of *Hydromys* are found in the New Guinea region. By the same token, the Australian water-rat is not closely related to either the European water vole (a.k.a. water-rat) or the American muskrat.

Several subspecies of *H. chrysogaster* have been proposed over time, generally based on variation in fur colour. Confirmation that valid subspecies occur will probably depend on the findings of future genetic studies.



Illustrations of the Australian water-rat in John Gould's early 19th century *Book of Australian Mammals* – four species of “Beaver rats” were recognised at that time.

L to R: Golden-bellied, Fulvous, White-bellied and Sooty.

ECOLOGY AND BEHAVIOUR

Foraging behaviour and diet

Water-rats mainly consume aquatic prey (including fish, frogs, turtles, crayfish, crabs, large aquatic insects, mussels and clams), but the remains of terrestrial prey (such as mice and bats) have also been discovered in water-rat faeces. It has been suggested that the proportion of foraging on land may increase in winter when water temperature declines.

Large water-rats have occasionally been documented to kill reasonably large water birds, such as ducks and coots. They will also eat carrion and scavenge for human food scraps. Based on anecdotal reports, water-rats will travel several hundred metres across dry land to dine on delicacies, such as pet food left out regularly on a back porch.



Water-rats are excellent climbers (above left). In addition to sometimes scaling trees to look for prey such as birds and bats, they have been reported running along the roof rafters at Flinders Street Railway Station in central Melbourne.

A water-rat snacks on bread on the banks of the Queanbeyan River (above right).

Water-rats also appear to have the rare ability to be able to kill the introduced cane toads found in Australia's tropical north. By flipping the toads over before biting them, they avoid the poisonous parotid glands found on the back of the toad's neck.

After catching their prey, water-rats typically carry it in their mouth to a favourite feeding spot on a log or rock located at the water's edge or in the channel. Large piles of clam shells, crayfish claws or fish bones and scales can accumulate at such platforms — the remains of many water-rat meals.



A water-rat at a typical feeding platform – in this case, a log in the middle of a weir pool.

Home range size and movements

Water-rats are highly territorial, marking their home ranges with a strong scent reminiscent of the odour of cat urine. Apart from females raising dependent offspring, it is presumed that adult water-rats lead solitary lives.

Relatively little is known about home range size and movements in this species. An adult male radio-tracked along a small creek in Victoria was found to have a home range extending at least 3.9 kilometres, whereas three males living in Queensland had home ranges that extended at least 0.9-2.2 kilometres. An overland movement of at least 3 kilometres has also been recorded.

In places where populations are dense there is considerable fighting, as evidenced by a high frequency of bite marks on tails and hind feet. This suggests that juveniles have to disperse from their mother's home range fairly soon after becoming independent; however, nothing is known about this process.

Reproduction and life history

Water-rats can potentially breed throughout the year if conditions are favourable, but mating most typically occurs in late winter to early summer, with juveniles appearing from September to February. The gestation period is around five weeks long. Females generally first breed at the age of about a year and raise two or three litters of young in a good year. A female water-rat only has four nipples and typically raises just two to four babies in a given litter, suckling her young for about a month. After weaning, juveniles remain with their mother for a few more weeks before leaving home for good.

It is believed that water-rats normally survive for a maximum of about 3-4 years in the wild.

Burrows and activity patterns

Water-rats occupy burrows located in creek and river banks, or shelter in large hollow logs lying near the water. Radio-tracking studies undertaken by Australian Platypus Conservancy staff have shown that platypus and water-rats will use the same burrows, though probably not at the same time. On one occasion, an adult female platypus occupied a burrow a few weeks after it served as a nursery for a female water-rat with a litter of young. Such behaviour is not especially surprising given that platypus and water-rats are about the same size and both are known to make use of many different burrows over time. It remains unknown whether the two species are equally likely to dig a new burrow in the first place.



This water-rat is about to exit the water and enter a burrow.

Conservation issues

Water-rats are subject to predation by many different species, including snakes, large predatory fish, birds of prey, and cats, dogs and foxes. However, there is no reason to believe that water-rats have ever vanished from any area solely due to predation. By the same token, there is no evidence that any diseases have an important impact on water-rat numbers.

Because water-rats are warm-blooded carnivores which require a lot of food to fuel their energetic lifestyle, the main problem facing the species is most likely to be habitat degradation, if this in turn reduces the animals' aquatic food supply.

Given that water-rats have a fairly short natural lifespan (in most cases living no more than 3-4 years), local populations may decline in size and even disappear if females fail to reproduce successfully for several years in a row — for example, due to the combined effects of poor habitat quality and ongoing drought.

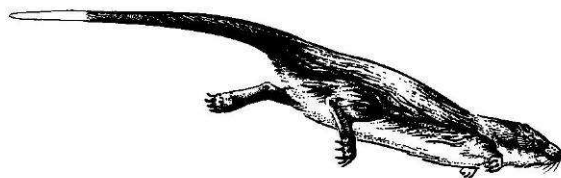
Water-rats were once widely trapped for their fur and sometimes culled when they were perceived to be a nuisance in irrigation districts. However, they are now fully protected by law as native wildlife.



In theory, water-rats can chew a hole to escape from a submerged opera house trap. In actual fact, the animals often drown before they can escape.

Unfortunately, many continue to drown in “opera house” traps and other enclosed nets designed to capture yabbies and freshwater crayfish. These nets are also known to kill large numbers of platypus and freshwater turtles. Recreational anglers are therefore strongly advised to consider using lift-style hoop nets or old-fashioned baited lines (without hooks) as wildlife-friendly alternative methods for procuring a meal of yabbies or crays.

Australian water-rats can sometimes come into conflict with humans when they raid fish farms or chicken yards, kill free-ranging guinea pigs in gardens, steal bait from anglers, leave piles of food debris on the decks of moored yachts or on verandahs, or deposit chewed up cane-toads around the edge of swimming pools! However, killing or relocating “problem” water-rats is illegal and subject to substantial fines. In any case, such action is likely to be totally ineffective because dispersing juveniles are likely to recolonise the area in a relatively short space of time. A much more sustainable solution is to learn to live with water-rats by rat-proofing problematic areas and not leaving food around that will attract them.



Co-existence of water-rats and platypus

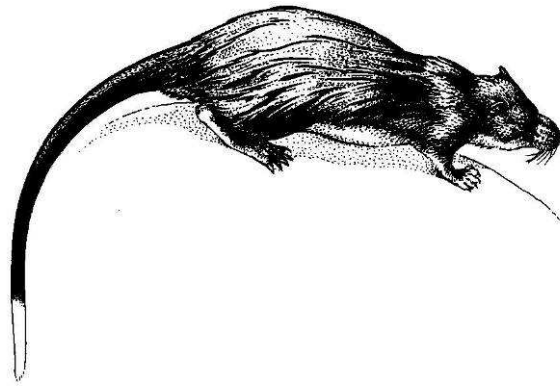
Platypus and water-rats both function as top predators in Australian freshwater systems and probably compete to some extent for food. However, the size of prey that can be consumed by an adult platypus is limited by the fact that its bill is equipped only with rough grinding pads to help process food. In contrast, a water-rat has a formidable set of sharp incisors to help kill and dismember prey. Interestingly, the grinding surfaces of water-rat molars are quite smooth. Like the grinding pads of the platypus, this adaptation may be particularly effective at dealing with the hard, encased bodies of many aquatic invertebrates.



In practice, very little is known about the ecological and behavioural interactions between platypus and water-rats. The two species are found living together in many places, so water-rats clearly do not automatically exclude platypus from freshwater environments (and vice versa).

However, there are also waterways where only one of the two species is commonly found. In general terms, water-rats are much more likely to persist in badly degraded aquatic habitats than the platypus. This may reflect the fact that the water-rat is able to forage on land and also prey on introduced fish species.

It has been suggested that water-rats may sometimes prey on young platypus but there appears to be no actual documented evidence to support this idea.



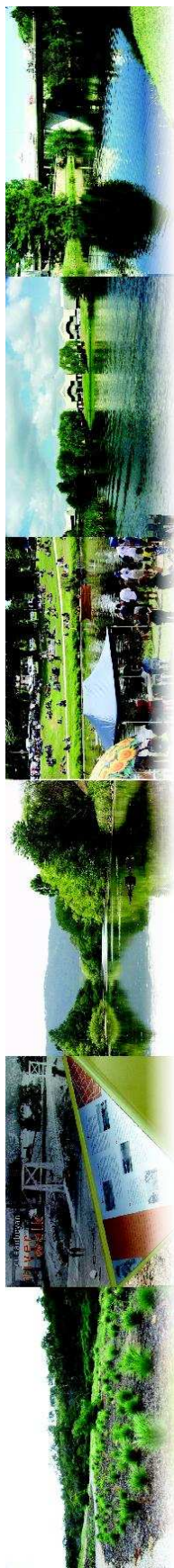
Further reading:

Fleay, D. (1990). The shy, water-loving aristocRAT. Wildlife Australia (summer): 12-15.

*Gardner, J.L. and Serena, M. (1995). Observations on activity patterns, population and den characteristics of the water rat *Hydromys chrysogaster* (Muridae: Hydromyinae) along Badger Creek, Victoria. Australian Mammalogy 18: 71-75.*

Watts, C.H.S. and Aslin, H.J. (1981). The Rodents of Australia. Angus & Robertson, Sydney.

Appendix C: Community brochure



Queanbeyan River Corridor Plan of Management & Platypus Awareness and Conservation Strategy

How you can get involved:

- * Come along to one of our events to speak directly to the consultants.
- * Email your comments to Eco Logical Australia queanbeyanriverplan@ecoaus.com.au
- * Call Beth Medway from Eco Logical Australia on 8536 8612 or 1300 646 131
- * Written responses to:

Queanbeyan River Project
Queanbeyan City Council
PO Box 90
Queanbeyan NSW 2620

Public Displays

Thursday 2nd June, 5pm - 8pm
@ Riverside Plaza Food Court
Saturday 4th June, 10am - 12 noon
@ 'The Q' Foyer

Enviro Expo

Sunday 5th June
Queanbeyan Conference Centre
APC Platypus talk @ 10am

Guided Walks

Saturday 4th June @ 1pm
Meet at the steps of 'The Q'
Sunday 5th June @ 7am
Meet at River Drive Reserve

It's your chance to have your say
on the future of the River Corridor!

Copies of the existing Plan
of Management are
available on Council web-
site: www.qc.nsw.gov.au

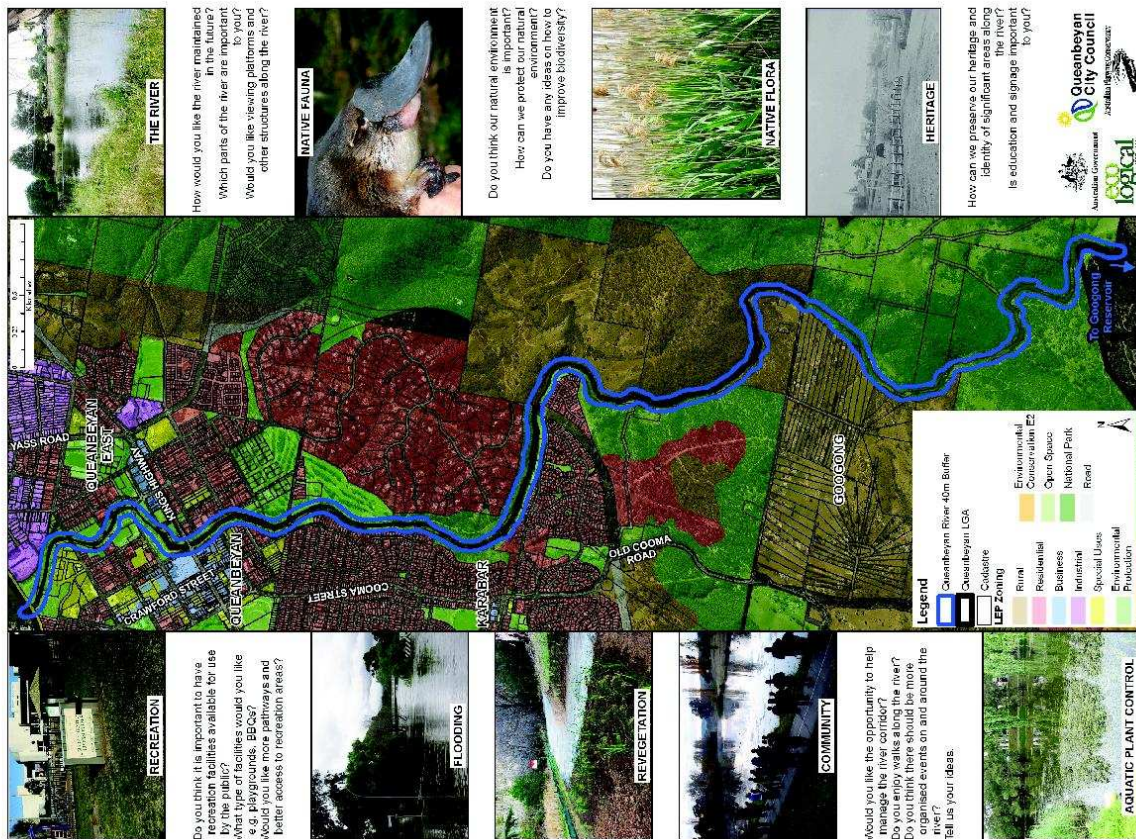


Join in on a walk along
the River, have a chat to
our consultants at one of
the public displays!
or
Leave comments on the
email

queanbeyanriverplan@ecoaus.com.au



Queanbeyan River Corridor Plan of Management



Why is Council preparing a new Plan of Management for the River?

Council is asking the community, government agencies, private individuals and businesses to give some direction for the future management of the Queanbeyan River. Please assist in supporting this project by providing your comments and ideas in this initial phase of consultation. The aim is to collect background data and information to prioritise the key issues and actions which must be addressed along the River over the next 10 - 20 years.

The project is two fold:

1. To revise a New Plan of Management (PoM) for the Queanbeyan River Corridor.
2. To prepare a Platypus Awareness and Conservation Strategy.

Funding for this project has been made possible due to The Australian Government's Water for the Future initiative and the Strengthening Basin Communities program. The objective of this program is to support local governments to prepare or update plans for adaptation for a future with less water.

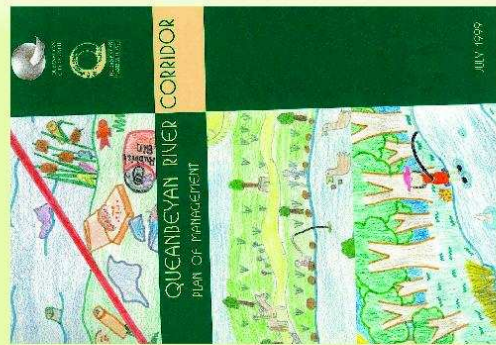
The existing Queanbeyan River Corridor Plan of Management was prepared and adopted by Council in 1999. The document is now 11 years old and dated. It has limited direction for the future and is missing critical elements such as climate change adaptation. This document is available on Council website or at the Queanbeyan City Library.

Information will be collated and used to prepare the two Draft Reports. These documents will contain actions to be prioritised, funded and implemented over the next 10 years.

The Plan will cover such issues as:

- * Land Description
- * Flora & Fauna
- * Zoning
- * Heritage & Culture
- * Values
- * Water Quality
- * Vision
- * Visual Amenity
- * Recreation & Use
- * Education & Interpretation

PRIVATE LAND - While Council acknowledges that this Plan is not able to specifically control areas of private land, it is important to recognise that much of the land adjoining the river and in the broader catchment is in private ownership and control. Landowners and managers are welcome to use the principles and objectives detailed in the Plan to guide their own management practices along the River. In fact there are many cases where it is beneficial for the Council and adjoining landowners to work together to restore and rehabilitate areas of the River. Recent examples include willow removal and revegetation, noxious weed control or riparian zone protection and rehabilitation.



Appendix D: A0 poster

Queanbeyan River Corridor Plan of Management

You are invited to participate in development of the Queanbeyan River Corridor Plan of Management

To register an interest in attending the consultation
sessions or to be on our project mailing list, please:

Email queanbeyanriverplan@ecolus.com.au
Call Queanbeyan City Council on 6285 6268
Write Queanbeyan City Council, PO Box 90,
Queanbeyan NSW 2620

You are welcome to attend:
An open display at the Riverside Plaza on Thursday
2nd June 5pm to 7pm
An open display at The Q foyer on Saturday 4th
June 10am to 12 noon
A walk along the river corridor between the CBD
and Glebe Park on Saturday 4th June from 1pm.
Meet at the front steps of The Q building
A walk along the river corridor between River Drive
and Dane Street on Sunday 5th June from 7am.
Meet at River Drive Reserve
Council's Environment Expo on Sunday 5th June at
Queanbeyan Conference Centre,
252 Crawford Street, Queanbeyan



How would you like the river maintained in the future?
Which parts of the river are important to you?
Would you like viewing platforms and other structures along
the river?



Do you think our natural environment is important?
How can we protect our natural environment?
Do you have any ideas on how to improve biodiversity?



Do you think it is important to have recreation facilities
available for use by the public?
What type of facilities would you like e.g. playgrounds, BBQs?
Would you like more pathways and better access to recreation
areas?



Would you like the opportunity to help manage the river
corridor?
Do you enjoy walks along the river?
Do you think there should be more organised events on and
around the river?
Tell us your ideas.



How can we preserve our heritage and identity of significant
areas along the river?
Is education and signage important to you?



Appendix E: Community notice

Queanbeyan River Corridor Plan of Management

12 April 2011

Queanbeyan City Council has engaged specialist consultants Eco Logical Australia and the Australian Platypus Conservancy to prepare the 'Queanbeyan River Corridor Plan of Management and Platypus Awareness and Conservation Strategy'.

The project is funded through the Australian Government's 'Water for the Future' initiative and the 'Strengthening Basin Communities' program.

The Plan of Management will identify actions to be implemented over the next ten years and provide a vision for the river corridor to be achieved by 2030.

The community is encouraged to participate in the project by providing information about the river corridor and ideas for future management.

In the initial stages of the project, the community is invited to:

- An open display on Thursday 2nd June 5 pm to 7 pm at Riverside Plaza Food Court
- An open display on Saturday 4th June 10 am to 12 noon at The Q foyer
- A walk along the river corridor between the CBD and Glebe Park on Saturday 4th June from 1 pm. Meet at the front steps of The Q building
- A walk along the river corridor between River Drive and Barracks Flat on Sunday 5th June from 7 am. Meet at River Drive Reserve
- Council's Environment Expo on Sunday 5th June at the Queanbeyan Conference Centre, 252 Crawford St, Queanbeyan

The community will have further opportunity to comment on the project when the Draft Plan of Management is on public exhibition at the end of 2011.

To register an interest in this project, please send your contact details to queanbeyanriverplan@ecoaus.com.au or to Natasha Abbott, Manager Environment and Health, Queanbeyan City Council, PO Box 90, Queanbeyan NSW 2620 or phone 6285 6000.

Appendix F: Initial feedback

Many long-term residents described changes in the river condition and morphology over the years, particularly in response to construction of dams and weirs, flood/drought conditions, and willow infestation and removal. People felt that the river is a significant natural asset that should be protected and improved. Most respondents have used the corridor for recreation (e.g. walks, canoeing) and/or value it for amenity (e.g. views). A number of people have been actively involved in on-ground works along the corridor (e.g. weed removal and planting natives).

The community provided valuable insights to what they would like to see happen in the river corridor. The main, consistent themes were:

- Council has done an excellent job in removing the willows to open up the river, and this should continue
- Native species should be planted where the willows have been removed to prevent erosion, improve habitat for native animals and improve the appearance of the river banks
- Ongoing weed and rubbish control is needed
- There should be a continuous public access path along or near the river, preferably on both sides with varying distance loop walks available

All comments have been grouped below according to topic and are essentially as they were provided to the consultants and Council. The comments have been reviewed during preparation of the Plan and those that are supported by Council have been included as actions in **Section 4**.

Weeds

- Question why exotic trees have been planted along edge of River Drive
- Weeds that are starting to take hold, especially now that the willows have been removed, include ivy, privet and blackberry
- Weed infestation (blackberries) in some difficult-to-access areas on the opposite side of the river to River Drive
- Weeds in Council's land
- Weeds being removed from River Drive are being dumped in the river
- Blackberries should be removed from land near small acreage at Googong
- Need different treatment to remove prickly pear from near pump station (River Dr) because previous techniques haven't worked
- Woody weeds and privet should be removed from golf course side of the river, and natives planted
- Council should remove environmental weeds from public land
- Aquatic weeds are enhanced by fertiliser washed into river after rain
- The two tributaries upstream of Dane Street gorge need rehabilitation – Valley Creek runs into rural land on the east side of the river, Barracks Creek on the western side is mostly in a reserve but has severe blackberry infestation and will come under further pressure as Edwin Land Drive is being built
- Replace invasive street tree species (e.g. *Photinia* on Woodger Pde)

- Establish a weed removal service in collaboration with Parkcare groups and Australian Native Plant Society (and their weed swap strategy)

Landscape

- Concrete paths are good near the CBD, but there should be even, 'natural' tracks elsewhere to be consistent with bushland surrounds
- Non-natives (e.g. English elm and black poplar) in parkland between Glebe Park and Queens bridge have historic value and match the historic buildings in the area
- Don't want more sealed paths; prefer unsealed paths to fit in with the landscape
- Don't get landscape architect to prepare plans for revegetation/rehabilitation
- Prefer the river corridor to be more natural
- Buttle Creek underpass is good location for community involvement and beautification. Consider building stormwater treatment devices (e.g. GPT, constructed wetland). Extend the work done by Landcare in Buttle Creek closer to the main river
- Prefer a natural bushland setting

Water quality/Stormwater

- Stormwater silt trap near River Drive is not effective because the river silts up, although this impact may decrease now that much of the building construction in the area has finished
- Problems with stormwater pollution include apparent high volume of detergent (or similar) discharged to river. Need better stormwater controls and education – especially for future development areas
- All tributaries should be subject to rehabilitation and stormwater controls
- Stormwater pipe discharging into river opposite Dane Street is an eyesore and needs better control
- Current and future areas need much better treatment of stormwater and sewage
- Queanbeyan township causes water quality problems mainly because of untreated stormwater from older areas
- Water quality is affected by eroded area of Jumping Creek, debris from stormwater (need more controls), and fertiliser from golf course (especially on the 16th fairway)
- Small acreage properties are on septic and pump water out of river
- Aquatic weeds are enhanced by fertiliser washed into river after rain
- Fertiliser use e.g. from golf course and playing fields is a problem because it causes algal blooms and aquatic weed proliferation

Native vegetation / habitat

- All areas adjacent tracks/paths should have landscaping with native species
- Need to revegetate with natives – consider microhabitat when selecting species
- Rehabilitation along River Drive is successful
- Need strategy to replace exotic trees with natives
- Rehabilitate habitats
- Want more habitat in the river e.g. snags for birds to roost
- Revegetation should use species that are indigenous to the area, not just native plants (or exotics)
- Need replanting with natives (including shrubs to encourage small birds) to prevent weeds invading areas that were cleared of willows and during the floods

- Landcare activities at Buttle Creek, Gale, off River Drive, Glebe Park (with local residents' group); also do seed collection and propagation
- Gale area has good benchmark sites for vegetation communities on different soil types
- Need more reeds in shallow sections of the river – to improve water quality and habitat

Impacts on fauna

- Pest fauna (e.g. foxes, feral cats, white ducks) should be removed
- A number of residents have seen native fauna (e.g. platypus, water rats, wombats) in the corridor. Others were surprised that native animals are in the area
- Fishing should focus on getting the carp out of the river
- Hunting native animals with guns and bows has happened and the police have been involved
- Changes in vegetation after 1984 fires – some areas have native species (*Melaleuca* sp.?) become monoculture
- Quest is a new community environmental group that would like to be involved in rehabilitation projects
- What impact will new urban development at Googong have on the river?
- 'Platypus sanctuary' in front of houses that have river frontage
- BFD virus is making many parrots sick (sulfur crested cockatoos, corellas and galahs)
- Investigate how a fishway could be constructed with the weir
- Need shrubs on caravan park side of the weir to provide cover for platypus and other species that need to move across
- Need comprehensive ecological survey
- Legless lizard (threatened species) was seen between Dane St and Barracks Flat Creek – so shouldn't have heavy machinery in these areas
- Rabbits are increasing and need to be controlled
- Research needed regarding the effect of removal of heavily seeding environmental weeds on bird species – possibly in collaboration with Birds Australia
- Gale area is an important biodiversity corridor

Recreational

- Improve the playground areas and immediate surrounds so that they have gas BBQ, picnic tables, lighting, area of good lawn (e.g. for Tai Chi), a shade/rain cover and exercise equipment.
- Need paths wide enough to allow children's bikes
- A few seats should be provided along the track network, but keep infrastructure minimal because prefer bushland setting
- Extend the track system along the river to provide linkages to Googong Dam upstream, and downstream to recreational tracks in the ACT. This could become a tourist attraction
- Doesn't matter if the paths are within the flood zone – it is more important to have a path network than delay constructing one because of negotiations with landholders who have property in the river corridor
- Canoeing and kayaking are popular activities now that the river is more open
- Small sandy beaches are good
- Glebe Park is very popular because the BBQ is within the fenced playground, toilets are good and clean, and there is plenty of parking. This should be a benchmark for other playgrounds in the area
- CBD area should be more formal with space for events like the regatta

- Open areas and playgrounds should have shade trees
- Need a picnic table near the low level bridge
- Install bubblers along paths
- There should be more river walks for the community (Waterwatch will organise these)
- Should be more community activities like the regatta, and these should be promoted more
- Have designated fishing areas, especially for kids
- Potential for kayak tours
- Parkland near the CBD needs more local vegetation to enhance views and improve ecosystem sustainability
- Need more footpaths near the swinging bridge
- Keep some open areas along the river with improved bike paths
- Need more seats to look over the river, especially near the CBD

Maintenance

- Need for better coordination and implementation of on-ground works (e.g. weed spraying and brush-cutting killing planted natives; heavy machinery rolling over planted natives)
- More 'clean up' is needed to remove rubbish and debris following floods, and on a regular basis
- More rubbish bins needed
- Stormwater silt trap near River Drive is not effective because the river silts up, although this impact may decrease now that much of the building construction in the area has finished
- Future removal of willows should include removal of all debris so that there is not the risk of problems (e.g. damage to downstream fences) if a flood occurs
- All stumps should be removed
- Need follow-up watering to any replanting, especially in summer
- Reinstate the old system of having permanent work crews to look after the river
- Need more community involvement in rehabilitation and monitoring
- Need plants to screen the view of the fire trail on the eastern side of the river from the opposite side of the river
- Need more bins and in easily accessible locations
- Steel marker poles near Dane Street should be removed
- Needs to be more clean up downstream of the low level bridge
- Quest is a new community environmental group that would like to be involved in rehabilitation projects
- Need ongoing maintenance, especially weed control and cleaning stormwater controls
- Weeds in the upper catchment are a big problem and will affect areas downstream
- Council should develop a weed management strategy and educate Council staff
- Council should prosecute private landowners that don't manage weeds
- Build barrier to stop people pushing shopping trolleys off the concrete ledge near the lower bridge
- Pipe culvert on the fire trail side near Greenleigh needs to be repaired
- Walkway on River Drive at Barracks Flat Creek should have a small culvert to cross the creek
- Need lots of follow-up to control weeds
- Don't build viewing platforms
- Need a concrete pathway between the suspension bridge and main bridge to give access to the coffee shop and art gallery without the need to negotiate the Queen's bridge

- Replace large rocks that were used to cross river before flood washed them away. Don't want more formal structures across river
- Bridge needs painting

Management

- Plan of Management should have measurable actions
- Council needs greater focus on managing natural resources and needs to apply for more grants to do this
- Need to report on how much of the previous plan of management has been achieved
- Need cross-border coordination of regional corridors
- Initiative to update the 1999 plan is welcome and the new plan should have firm policies regarding public access to the river corridor (on both sides of the river) and co-ordination of work by different agencies
- Need good coordination between agencies e.g. link in with the Molonglo Gorge, ACT Parks, Conservation and Lands work and ACT Woodlands Strategy
- In upper catchment there should be much wider riparian buffers in land use zones and if development is considered

Infrastructure

- Need to raise the road and walkway on the northern side of Queens Bridge so that it doesn't become inundated during floods and prevent access. This view was supported by the SES representative
- Infrastructure should be consistent with modern/heritage style of Queanbeyan
- There shouldn't be any permanent structures (e.g. kiosk, Riverside Sportsground club) in the flood zone
- A low level crossing should be constructed near River Drive
- Don't remove the weir
- Location of new paths should consider likely problems if it is in the flood zone compared to problems of being close to residences
- Need more carparking near the kiosk
- Investigate if the lower level bridge can be raised to cope with flood
- Need more litter traps on drainage lines, especially near the lower bridge

Public safety

- Lighting is needed under the bridge for public safety at night
- Remove old wood fire place and concrete tables at Trincolo Park. Focus on safety and amenity in these areas. May need low fence near river and/or sign to warn people of steep drop
- Introduce a low speed limit on roads next to the river because of public safety issues
- Need better, safe access along the golf course
- More signage needed, e.g. trail bikes prohibited, risk from golf balls near golf course

Education

- Community would like to know what controls/management apply to the sewer pump station near River Drive, especially if there is an overflow or malfunction
- Signage and education to encourage use of local dog park

- Educate private landowners about suitable plant species
- Need stormwater drain stencilling to raise community awareness about water pollution
- Needs signs for major features e.g. Queens Bridge, Queanbeyan River
- Nesting boxes have been installed in areas where the indigenous group has been working along the river. No data about species' use
- Platypus should be used in all signs and promotions for Queanbeyan – emblem
- Need more bins, education and enforcement to stop litter
- Molonglo Catchment Group / Landcare / Waterwatch encourage people to get involved e.g. planting, fauna monitoring, riparian survey
- Build a viewing hide/platform to watch wildlife (e.g. platypus) near the CBD. Construct using sustainable materials and create habitat. Install educational signs. Make this a showcase site
- Canoeists get involved in Clean Up Australia, which helps to get rubbish from inaccessible areas
- Need educational signs (e.g. to explain habitat features)
- Need maps to show paths/tracks, and to give background about history and the environment
- Community education needed regarding invasive weeds
- Need more education for landowners, especially those along the river
- Residents would like to work with Council to do appropriate replanting on private land
- Need better understanding of European heritage, including a heritage walk and signage
- Need to acknowledge Aboriginal history with signage near the CBD

Access

- Need access adjacent to the river where private property boundaries extend to the river. Council should consider acquisition or other means
- Residents of the blocks that extend to the river would fight against any proposed acquisition or attempt to provide public access through their lots. This would be a very expensive process
- Public access to the riverfront needs to be provided consistently i.e. same for caravan park and private property
- Need better access paths to the new kiosk between the suspension bridge and Queens Bridge
- New small bridge has been constructed but is not available for public use because of problems associated with accessing private land along river. Bridge has been fenced off. Need to investigate how to get public access between the new bridge and Council land (Kathleen Street). Steps could be constructed to low level adjacent the river or construct path along the existing maintenance track. Need revegetation
- Want a track from Googong to CBD, but sections are very steep
- Need to keep excising all unauthorised vehicles (4WD, trail bikes) from the corridor (and maintain fences, gates etc)
- In areas where the river edge is in private ownership, get a registered survey then develop a plan for Council to purchase at least 20 m along the river to provide public access
- River corridor should be a wildlife protection area and dogs should be restrained at all times
- Develop a walking track from Googong Dam to the Riverside Plaza and beyond to Lake Burley Griffin

- Residents who own land with river frontage at Thorpe Avenue do not want a pathway across their land

Caravan Park

- Caravan Park has approx. 40,000 visitors annually
- The caravan park is on Crown Land. It is owned by the NSW Government, managed by Council and leased by a private company (Marellen Pastoral Co.)
- There are eight years remaining on the current lease
- The leasee is negotiating to extend the lease or create a new lease for 25 years
- Council owns the amenities building and is responsible for maintenance
- The leasee would like to take responsibility for all maintenance, including to the river's edge, if the lease is extended to 25 years
- Problems with sewage overflows in the caravan park and into the river
- The caravan park is within the flood zone. A flood evacuation plan has been prepared. During recent flood the park was evacuated quickly, with no problem. However, the evacuation did not follow the plan i.e. evacuate to the Showground
- Consider viability of constructing a floating pontoon between the lower level of the caravan park (currently used by campers) and the new kiosk on the opposite side of the river
- Plant trees could be planted along river's edge to improve amenity and screen caravans from the other side of the river, including the kiosk
- Concern about additional cabins proposed for the caravan park
- Concern about caravans discharging wastewater directly into the river (observed during field inspection with the community)
- Need to audit impact of caravan park on river
- Remove caravan park to increase riparian area and public access, and improve water quality



Photo: Community participants in an early morning walk along the river



Photo: Representatives from ELA, APC and ACT Waterwatch at the Enviro Expo display



Photo: Display in local shopping centre

Previous consultation

For reference, the following issues were raised by the community during consultation for the previous Plan (Connell Wagner 1999):

- Maintain the natural beauty and character of the area/preserve the area in its natural beauty for future generations
- Improve water quality/clean up creek
- Provide planning framework for future change
- Consultation with ACTEW over environmental flows
- Protect and enhance the natural and cultural heritage values
- Connect sympathetically to adjoining residential, commercial and native areas
- Appropriate use/access, in safe and healthy ways for residents and visitors
- Maximise/optmise benefits to the community
- Promote ecologically viable and sustainable systems
- To protect and enhance the natural and cultural heritage of the river corridor

Consultation with agencies for this plan

The following agency representatives were contacted in July and/or August 2011.

DEPARTMENT	CONTACT PERSON
Waterwatch	Tanya Rucosky Noakes Dr Stephen Skinner
NSW Office of Environment and Heritage	Michael Saxon Paul Packard Phil Boot
NSW Office of Water	Tim Smith Steven Webb Daniella Doughtly
NSW Department of Primary Industries - Fisheries	Mathew Gordalous Luke Pierce Adam Lugg Charlie Curruthers Cameron Westaway Trevor Daly
Murrumbidgee CMA	Matt De Jongh
Dept of Lands	Steven Watts John Flarrety
SES	Steve Forbes

Appendix G: Public exhibition

This appendix presents the letter templates that were used to notify people of the public exhibition period. It also includes a summary of minutes taken from the public meeting and points raised in written submissions. Council has a separate consultation report that includes details of who attended the public meeting, who made submissions, copies of the submissions and an analysis.

S&BL :NA:na
File: SF100455

8 November 2011

ADDRESS 1
ADDRESS 2
ADDRESS 3

Dear Sir/Madam,

RE: EXHIBITION OF DRAFT PLAN OF MANAGEMENT
QUEANBEYAN RIVER CORRIDOR &
PLATYPUS AWARENESS AND CONSERVATION STRATEGY

At its meeting of 26 October 2011 Council endorsed the Draft Queanbeyan River Corridor Plan of Management incorporating Platypus Awareness and Conservation Strategy for public exhibition.

The plan provides actions to enhance the river corridor for public enjoyment and to protect the natural environment for the next 10 years. Attached to the document is the Platypus Awareness and Conservation Strategy. This document is interesting reading and provides everything you need to know about platypus and water rats and what the community can do to protect them for the future.

Council is pleased to provide you with a copy and would like to invite you to comment on the Plan of Management.

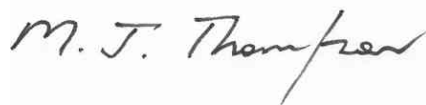
A public presentation of the two documents and an opportunity to speak to the consultants will be held on:

Thursday 17th November 2011
6.00pm
Harry Hesse Room
262 Crawford Street

All comments on the Draft Plan should be forwarded to: queanbeyanriverplan@ecoraus.com.au or post to the General Manager, PO Box 90, Queanbeyan NSW 2620. Submissions will be received until close of business on 12 December 2011.

Should you have any further enquiries please contact Natasha Abbott of Council's Sustainability and Better Living Group on (02) 6285 6268 during normal office hours.

Yours faithfully



M J Thompson
Group Manager
Sustainability and Better Living

S&BL :NA:na
File: SF100455

8 November 2011

ADDRESS 1
ADDRESS 2
ADDRESS 3

Dear Sir/Madam,

RE: EXHIBITION OF DRAFT PLAN OF MANAGEMENT
QUEANBEYAN RIVER CORRIDOR &
PLATYPUS AWARENESS AND CONSERVATION STRATEGY

At its meeting of 26 October 2011 Council endorsed the Draft Queanbeyan River Corridor Plan of Management incorporating Platypus Awareness and Conservation Strategy for public exhibition.

The document is now available for viewing as a hardcopy at the Queanbeyan City Library or at Council's main administration office at 257 Crawford Street. Alternatively the Plan can be downloaded from Council's website at www.qcc.nsw.gov.au.

The plan provides actions to enhance the river corridor for public enjoyment and to protect the natural environment for the next 10 years. Attached to the document is the Platypus Awareness and Conservation Strategy. This document is interesting reading and provides everything you need to know about platypus and water rats and what the community can do to protect them for the future.

Council would like to invite you to comment on the Plan of Management.

A public presentation of the two documents and an opportunity to speak to the consultants will be held on:

Thursday 17th November 2011
6.00pm
Harry Hesse Room
262 Crawford Street

All comments on the Draft Plan should be forwarded to: queanbeyanriverplan@ecoraus.com.au or post to the General Manager, PO Box 90, Queanbeyan NSW 2620. Submissions will be received until close of business on 12 December 2011.

Should you have any further enquiries please contact Natasha Abbott of Council's Sustainability and Better Living Group on (02) 6285 6268 during normal office hours.

Yours faithfully



M J Thompson
Group Manager
Sustainability and Better Living

Summary of community feedback

This section summarises the key points made at the community meeting and in written submissions.

- Need to resolve land ownership along Thorpe Ave and notify wider community of result
- Supports ongoing weed removal
- Need for Council staff education
- Church originally suggested native tree species be planted to commemorate 150 years, and would support relocation of Chinese elms or replacement with natives
- Need for weed control between Googong Dam and Fairlane Estate
- Need for consideration of landowners requirements in relation to quantity and quality of water releases from Googong Dam
- Support efforts to use platypus in tourism promotions
- Need for plan to have broader catchment approach
- Need for qualified Council staff to be responsible for care and promotion of river and natural areas
- The river corridor can be a vector for fire, possible refuge for the community and source of water in an emergency
- Need to provide access points along the river to obtain water for fire trucks
- Need more than one road access for entry/exit from residential areas
- Rubbish and rubbish bins should be removed from corridor
- Domestic pets and motor craft (including toys) should be banned from corridor
- Need small firebreak between bush and properties along river
- Remove trees growing close to homes along the river because of fire hazard
- Remove vegetation that is not indigenous to Queanbeyan and replant with native species e.g. *Casuarina cunninghamiana*
- Need to clarify if the land along Thorpe Ave is private or leasehold to the river.
- Queanbeyan Riverside Tourist Park won the 2011 Queanbeyan Business Excellence Award for the category of 'tourism, hospitality, events'
- Would like more details of the sewage spill
- Foreshore adjacent to the caravan park is not part of leased area therefore is Council's responsibility to maintain
- Implementation of the flood evacuation plan worked well and should be seen as a positive in the plan
- Believes that caravan park should be retained in current location because of links to CBD
- Welcome opportunities to be involved in environmental education and signage
- Support the actions
- Agree the caravan park should be removed
- Trail bikes are a problem after school and on weekends when there is no ranger
- Need to improve signage at Dane St
- Trail bike access should be made more difficult
- Council should manage dog e.g. educate owners to clean up; unrealistic to ban dogs
- Should have public access along river between Glebe Park and Glenrock Creek and on to Dane St
- Concern about stability of fire trail opposite Dane St and stormwater outflow from Greenleigh Estate
- Funds should be spent on fish restocking rather than a 'fish ladder'
- Additional information / clarification re flora species
- Support the strategy

- Supports retention of the caravan park, extension of the lease and preparation of a site-specific management plan
- Seeks retention of existing owner's rights along the river, including properties extending to the river's edge
- Seek sympathetic development along the river
- Seek to retain the two weirs with modifications to allow fish passage
- Seek balance between ecology and commercial/social activity in the urban area
- Propose that development controls not be overly prescriptive, particularly where private land is within the riparian corridor
- Funding assistance should be made available to private landowners for riparian improvements and rehabilitation works
- Priority should be given to funding improvements that are highly accessible/visible e.g. parklands adjacent the CBD
- Recommend review of the plan every two years or on an as needs basis e.g. when the flood management plan is completed, or legislation changes. Stakeholders should be allowed to comment during review process
- Development of more detailed plans should be done in consultation with affected landowners
- Referral of DAs within 40 m of top of bank to Council's ESAC is supported but should not delay processing DAs. Suggest that minor works be excluded from ESAC consideration
- Specific comments are given on a number of actions and would require minor rewording
- Plan should have a more strategic, whole-of-catchment approach and doesn't adequately deal with:
 - Growth at Googong township
 - Infestation of *Egeria densa* (leafy elodea) in Googong Dam and the threat to downstream waterways. *E. densa* is a Class 5 noxious weed
 - Adequacy of controlled flow releases from Googong Dam
 - The need for total catchment management principles to be applied to address declining water quality, erosion, weeds etc
 - The need to maintain and improve natural areas upstream of the junction Jumping Valley Creek (urban fringe)
 - Flood debris downstream of the lower level bridge
 - Recent planting of 200 Chinese elms, which is inconsistent with the Council's planting policy
- Submission proposes fourteen recommendations to be incorporated in the plan and endorsed for immediate action. These relate to:
 - Exotic weed control in the upper catchment
 - Studies to monitor water quality, sediment stability, *E. densa*, and publication of results on Council's website
 - Community awareness and involvement programs
 - Removal of flood debris
 - Review storage and release policies for Googong dam
 - Council culture and skills
 - Relocation of Chinese elms and replace them with native species
- Should adopt the structure and approach in the 1999 River Plan
- Plan is positive step to manage the river
- Prefer an 'urban wilderness park' with unpaved walking tracks and discrete signage in upper reaches
- No litter bins in the upper catchment
- Community education needed regarding wombats

- Opportunities for community involvement that don't have a 'conflict of interest'
- Maps to be made available on-line
- Need to protect and promote other iconic species such as wombat and lyrebird
- Support removal of the caravan park, and improvement of areas in front of Riverside Plaza and the Art Gallery
- Support a walking 'loop' that promotes heritage and biodiversity

Appendix H: Threatened flora and fauna

Threatened flora species recorded or potentially occurring in the study area

THREATENED FLORA SPECIES	STATUS		POTENTIAL HABITAT IN THE RIPARIAN CORRIDOR
	TSC Act	EPBC Act	
<i>Caladenia tessellata</i> Thick-lipped Spider Orchid	E	V	This species is generally found in grassy sclerophyll woodland on clay loam or sandy soils and is known from one record in the Queanbeyan LGA, within Dry Forest along the Queanbeyan River corridor.
<i>Pomaderris pallida</i> Pale Pomaderris	V	V	This species usually grows in open forest or shrub communities surrounded by Brittle Gum, Red Stringybark or Cypress Pine Woodland. In the Queanbeyan LGA, it is only known from two records in Dry Forest within the Queanbeyan River Corridor below Googong Reservoir and east of Wickerslack Lane.

Table modified from ELA 2008

Threatened fauna species recorded or occurring in the study area

THREATENED FAUNA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
Microchiropteran Bats			
Eastern Bentwing Bat <i>Miniopterus schreibersii oceanensis</i>	V	-	This bat uses caves as roosting sites and woodlands or forests for foraging. It has been recorded in the Queanbeyan LGA near the centre of Queanbeyan City, in the Googong area, in the Carwoola area, as well as just outside the LGA along the Queanbeyan River corridor south of Carwoola. Foraging, roosting and potential breeding habitat for this species is likely to be relatively widely distributed within the LGA in association with areas of woodland, forest, or scattered trees. Important roosting sites are most often associated with deeper caves or abandoned mines, and are likely to be scarce in the LGA.
Other Mammals			
Koala <i>Phascolarctos cinereus</i>	V	-	This species inhabits eucalypt woodlands and forests with a fragmented distribution through eastern Australia. The species is irregularly recorded in the Queanbeyan LGA and records are associated with the Queanbeyan River corridor. These records include a 2007 sighting on the eastern outskirts of Queanbeyan City in the riparian zone and a 1984 record from the north of Googong Dam.
Birds			
Australian Painted Snipe <i>Rostratula benghalensis australis</i>	V	V	This migratory species is usually found in vegetated, shallow (<50cm), temporary or infrequently filled wetlands, preferring the fringes of these habitats where there is a cover of grasses, lignum, low scrub or open timber. It has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp, although is most common in the Murray-Darling Basin. This species was recorded during the survey period but has not otherwise been recorded within the Queanbeyan LGA. It is possible that the species occurs occasionally in areas of wet grassland associated with the river and creek corridors within the LGA.
Barking Owl	V	-	This species is associated with open forests and woodlands across much of northern and eastern Australia but is considered to be sparse on the higher parts of the tablelands and rare in the ACT. The species preys on a range of terrestrial and arboreal mammals, birds and insects. Breeding habitat and

THREATENED FAUNA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
<i>Ninox connivens</i>			roosts are usually associated with large hollows in eucalypts and patches of dense cover in riparian areas or around wetlands. There are no recent records of the species in the LGA however there may be suitable habitats in association with the extensive areas of Dry Forests found on the Queanbeyan Escarpment and in the Queanbeyan River Corridor.
Diamond Firetail <i>Stagonopleura guttata</i>	V	-	This species is found in grassy eucalypt woodlands, including Box-Gum Woodlands and also occurs in NTG, and in secondary grasslands. It is often found in riparian areas and is known from the Queanbeyan River corridor, south of Carwoola and has also been recorded east of Tralee, in woodland at Tralee Station, east of Jerrabomberra and, immediately beyond the Queanbeyan LGA, to the east of Googong and west of Burra Creek.
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i>	V	-	This species has been recorded in Dry Forest along the Queanbeyan River corridor, just outside the Queanbeyan LGA south of Carwoola and in Queanbeyan East. Potential foraging habitat for this species is likely to be relatively widely distributed within the LGA in association with remnant woodlands and forests. Potential breeding habitat is likely to be much more restricted as the species prefers taller forests with an abundance of old growth attributes.
Hooded Robin <i>Melanodryas cucullata</i>	V	-	This species generally prefers lightly wooded country, usually open eucalypt woodland, and often occurs in or near clearings or open areas. It requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. The species is known from a cluster of records just outside the LGA south of Carwoola along the Queanbeyan River corridor and around the north-western shores of Googong Reservoir. It has also been recorded on Tralee Station, near Jerrabomberra and outside the Queanbeyan LGA west of Burra Creek. Potential habitat for the species is likely to be relatively widespread within the LGA in association with remnant woodlands and forests and concentrated in those areas where larger more structurally diverse patches of remnant vegetation are concentrated such as in the north-eastern and eastern extremities of the LGA and in the Mt Jerrabomberra, Barracks Creek, Jerrabomberra Creek and the Queanbeyan River Corridor areas.
Masked Owl <i>Tyto novaehollandiae</i>	V	-	This species inhabits eucalypt forests and woodlands from the coast to the western plains. The study area is likely to include a reasonable amount of potential habitat for the species as it prefers habitats that provide a mosaic of sparse grassy and dense shrubby ground cover on gentle terrain. However it is also known to prefer forests with high densities of old hollow trees and to avoid young regrowth areas. There are no recent records of the species in the LGA however the most likely suitable habitats for the species within the study area would appear to be in association with the extensive areas of Dry Forests found on the Queanbeyan Escarpment and in the Queanbeyan River Corridor.

THREATENED FAUNA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
Powerful Owl <i>Ninox strenua</i>	V	-	Habitat for this owl species tends to be within eucalypt forest containing a diverse array of understorey plants and appropriate habitat for its primary prey species (gliders and large possums and especially Ringtail Possums). Given the likely paucity of large hollows suitable for breeding and the relatively low abundance of preferred prey species resulting primarily from historical vegetation modification, potential habitat for this species is likely to be relatively limited within the study area. There are no recent records of the species in the LGA however there is a recent record from Canberra. The most likely suitable habitats for the species within the study area would appear to be in association with the extensive areas of Dry Forests found on the Queanbeyan Escarpment and in the Queanbeyan River Corridor.
Speckled Warbler <i>Pyrrholaemus sagittatus</i>	V	-	The Speckled Warbler lives in a wide range of eucalypt dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. In the Queanbeyan LGA, the species is known to occur in the Tralee – Poplars-Jerrabomberra Creek area, around the Queanbeyan River corridor and on the western shores of Googong Reservoir. Potential habitat within the LGA is likely to be relatively widely distributed in association with larger patches of remnant native vegetation.
Superb Parrot <i>Polytelis swainsonii</i>	V	V	This species occurs throughout eastern inland NSW and inhabits Box-Gum Woodlands. It utilises hollows in large Blakely's Red Gum, Yellow Box, Apple Box and Red Box for nesting. This species forages in Box-Gum Woodland up to 10km from nesting sites and feeds in trees, on the ground and in understorey shrubs. Potential habitat for this species is relatively widespread within the LGA in association with grassy woodlands, however it has not been recorded within the LGA with the majority of records being in the northern parts of the ACT, including in residential areas.
Reptiles			
Pink-tailed Worm-lizard <i>Aprasia parapulchella</i>	V	V	This species inhabits sloping, open woodland areas with predominantly native grassy ground layers, particularly those dominated by Kangaroo Grass. Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. This species occurs at "Talpa" near Googong and is also known from east of Jerrabomberra Creek north of Fernleigh Park on a lightly timbered southwest slope, with scattered surface rocks, Queanbeyan East, east of Karabar along the Queanbeyan River, and from Beatty Hill. However potential habitat for the species is likely to be present in those areas within the LGA supporting Grassy Woodlands or Native Grasslands or pasture with partially embedded surface rocks.
Rosenberg's	V	-	Rosenberg's Goanna is found in heath, open forest and woodland. Termite mounds are a critical habitat component for this species, as they are used for nesting. The species shelters in hollow logs, rock crevices and in the burrows, of other species, including rabbits, or in burrows they dig for themselves.

THREATENED FAUNA SPECIES	STATUS		POTENTIAL HABITAT AND KNOWN LOCATIONS IN THE QUEANBEYAN LGA
	TSC Act	EPBC Act	
Goanna <i>Varanus rosenbergi</i>			The Canberra – Queanbeyan Landscape Unit, which lies in and beyond the north-western part of the Queanbeyan LGA contains the most frequent sightings of Rosenberg's Goanna. Within the Queanbeyan LGA, there are recorded sightings of this species, in the Gale Precinct, in Cuumbeun NR south of Captains Flat Road, along the Queanbeyan River in the south east of Karabar and in the northeast of Googong. Suitable foraging and breeding habitat for this species has also been reported to occur in North Terrace and Jerrabomberra Heights.

Table modified from ELA 2008

Appendix I: Weeds

Noxious Weeds

Under the NSW *Noxious Weeds Act*, the following plants are declared noxious weeds within the Queanbeyan Local Government Area. Source: NSW Primary Industries (Agriculture) noxious weed declarations for Queanbeyan City Council website (<http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed/noxious>).

BOTANICAL NAME	COMMON NAME	CLASS*	CATEGORY
<i>Lycium ferocissimum</i>	African Boxthorn	4	Regional
<i>Pennisetum macrourum</i>	African Feathergrass	5	All of NSW
<i>Eragrostis curvula</i>	African Love Grass	4	Regional
<i>Sisymbrium runcinatum</i>	African Turnipweed	5	All of NSW
<i>Sisymbrium thellungii</i>	African Turnipweed	5	All of NSW
<i>Alternanthera philoxeroides</i>	Alligator Weed	2	National
<i>Eichhornia azurea</i>	Anchored Water Hyacinth	1	All of NSW
<i>Ambrosia artemisiifolia</i>	Annual Ragweed	5	All of NSW
<i>Sagittaria montevidensis</i>	Arrowhead	4	All of NSW
<i>Cynara cardunculus</i>	Artichoke Thistle	5	All of NSW
<i>Tamarix aphylla</i>	Athel Tree	5	National
<i>Xanthium</i> spp.	Bathurst/Noogoora/ Californian/Cockle Burrs	4	
<i>Festuca gautieri</i>	Bear-Skin Fescue	5	All of NSW
<i>Centaurea nigra</i>	Black Knapweed	1	All of NSW
<i>Rubus fruticosus</i> (agg. spp.)	Blackberry	4	All of NSW
<i>Chrysanthemoides monilifera</i>	Boneseed	2	National
<i>Asparagus asparagoides</i>	Bridal Creeper	4	National
<i>Orobancha</i> spp. (except <i>O. cernua</i> var. <i>australiana</i> and <i>O. minor</i>)	Broomrapes	1	All of NSW
<i>Ambrosia confertiflora</i>	Burr Ragweed	5	All of NSW
<i>Cabomba</i> spp	Cabomba	5	All of NSW
<i>Stachytarpheta cayennensis</i>	Cayenne Snakeweed	5	All of NSW
<i>Nassella neesiana</i>	Chilean Needle Grass	4	National
<i>Asystasia gangetica</i> subspp. <i>Micrantha</i>	Chinese Violet	1	All of NSW
<i>Gaura parviflora</i>	Clockweed	5	All of NSW
<i>Sonchus arvensis</i>	Corn Sowthistle	5	All of NSW
<i>Cuscuta</i> spp. Except <i>C. australis</i> , <i>C. tasmanica</i> and <i>C. victoriana</i>	Dodder	5	All of NSW
<i>Hygrophila polysperma</i>	East Indian Hygrophila	4	

BOTANICAL NAME	COMMON NAME	CLASS*	CATEGORY
<i>Amelichloa brachychaeta</i> <i>Amelichloa caudate</i>	Espartillo	5	All of NSW
<i>Myriophyllum spicatum</i>	Eurasian Water Milfoil	1	All of NSW
<i>Cenchrus brownii</i>	Fine-Bristled Burr Grass	5	All of NSW
<i>Pennisetum setaceum</i>	Fountain Grass	5	All of NSW
<i>Cenchrus biflorus</i>	Gallon's Curse	5	All of NSW
<i>Carthamus glaucus</i>	Glaucus Starthistle	5	All of NSW
<i>Cuscuta campestris</i>	Golden Dodder	4	
<i>Scolymus hispanicus</i>	Golden Thistle	5	All of NSW
<i>Ulex europaeus</i>	Gorse	3	National
<i>Cestrum parqui</i>	Green Cestrum	3	
<i>Harrisia</i> spp.	Harrisia Cactus	4	All of NSW
<i>Hieracium</i> spp.	Hawkweed	1	All of NSW
<i>Conium maculatum</i>	Hemlock	4	All of NSW
<i>Heteranthera reniformis</i>	Heteranthera	1	All of NSW
<i>Equisetum</i> spp.	Horsetail	1	All of NSW
<i>Hydrocotyl ranunculoides</i>	Hydrocotyl	1	All of NSW
<i>Hymenachne amplexicaulis</i>	Hymenachne	1	National
<i>Acacia karroo</i>	Karoo Thorn	1	All of NSW
<i>Bassia scoparia</i> , except <i>Bassia scoparia</i> subspecies <i>thichophylla</i>	Kochia	1	All of NSW
<i>Clidemia hirta</i>	Kosters curse	1	All of NSW
<i>Lagarosiphon major</i>	Lagarosiphon	1	All of NSW
<i>Lantana</i> spp.	Lantana	4	National
<i>Egeria densa</i>	Leafy Elodea	4	All of NSW
<i>Phylla canescens</i>	Lippia	4	All of NSW
<i>Ludwigia longifolia</i>	Long-Leaf Willow Primrose	4	
<i>Nassella tenuissima</i>	Mexican Feather Grass	1	All of NSW
<i>Argemone mexicana</i>	Mexican Poppy	5	All of NSW
<i>Miconia</i> spp.	Miconia	1	All of NSW
<i>Mikania micrantha</i>	Mikania	1	All of NSW
<i>Mimosa pigra</i>	Mimosa	1	National
<i>Cenchrus echinatus</i>	Mossman River Grass	5	All of NSW
<i>Carduus nutans</i>	Nodding Thistle	4	
<i>Romulea</i> spp. (except <i>R. rosea</i> var. <i>australis</i>)	Onion Grass	5	
<i>Oxalis</i> (except <i>O. chnoodes</i> , <i>O. exilis</i> , <i>O. perennans</i> , <i>O. radicata</i> , <i>O. rubens</i> and <i>O. thompsoniae</i>)	Oxalis	5	
<i>Cortaderia</i> spp.	Pampas Grass	4	
<i>Parthenium hysterophorus</i>	Parthenium Weed	1	All of NSW
<i>Echium</i> spp.	Paterson's Curse, Viper's Bugloss, Italian Bugloss	4	
<i>Annona glabra</i>	Pond Apple	1	National

BOTANICAL NAME	COMMON NAME	CLASS*	CATEGORY
<i>Acacia nilotica</i>	Prickly Acacia	1	National
<i>Cylindropuntia</i> spp.	Prickly Pear	4	National
<i>Opuntia</i> spp. (except <i>O. ficus-indica</i>)	Prickly Pear	4	National
<i>Orzya rufipogon</i>	Red Rice	5	All of NSW
<i>Toxicodendron succedaneum</i>	Rhus Tree	4	All of NSW
<i>Cryptostegia grandiflora</i>	Rubbervine	1	National
<i>Sagittaria</i>	Sagittaria Platyphylla	5	National
<i>Salvinia molesta</i>	Salvinia	2	National
<i>Cytisus scoparius</i>	Scotch Or English Broom	4	National
<i>Onopordum</i> spp.	Scotch/Illyrian/Stemless/ Taurian Thistles	4	
<i>Gymnocoronis spilanthoides</i>	Senegal Tea Plant	1	All of NSW
<i>Nassella trichotoma</i>	Serrated Tussock	4	National
<i>Chromolaena odorata</i>	Siam Weed	1	All of NSW
<i>Brassica barrelieri</i> sub spp. <i>oxyrrhina</i>	Smooth – Stemmed Turnip	5	All of NSW
<i>Picnomon acarna</i>	Soldier Thistle	5	All of NSW
<i>Centaurea maculosa</i>	Spotted Knapweed	1	All of NSW
<i>Hypericum perforatum</i>	St John's Wort	3	
<i>Rosa rubiginosa</i>	Sweet Briar	4	
<i>Helianthus ciliaris</i>	Texas Blueweed	5	All of NSW
<i>Ailanthus altissima</i>	Tree Of Heaven	4	
<i>Solanum viarum</i>	Tropical soda apple	2	
<i>Trapa</i> spp.	Water Caltrop	1	All of NSW
<i>Eichhornia crassipes</i>	Water Hyacinth	2	National
<i>Pistia stratiotes</i>	Water Lettuce	1	All of NSW
<i>Stratiotes aloides</i>	Water Soldier	1	All of NSW
<i>Salix</i> spp. (except <i>S. babylonica</i> , <i>S. reichardtii</i> , <i>S. calodendron</i>)	Willows, except weeping and pussy willow	5	All of NSW
<i>Striga</i> spp. (except <i>S. parviflora</i>)	Witchweed	1	All of NSW
<i>Limnocharis flava</i>	Yellow Burrhead	1	All of NSW
<i>Cyperus esculentus</i>	Yellow Nutgrass	5	All of NSW

***Control categories**

CATEGORY	DESCRIPTION
1	The plant must be eradicated from the land and the land must be kept free of the plant
2	The plant must be eradicated from the land and the land must be kept free of the plant
3	The plant must be fully and continuously suppressed and destroyed
4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority. The plant may not be sold, propagated or knowingly distributed.
5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with

Other weeds to watch

In addition to noxious weeds identified above, there are a number of other weeds and exotic species that are particularly of concern in the riparian corridor of Queanbeyan but may not be a problem elsewhere. The following list has been compiled by the Molonglo Waterwatch coordinator (pers. com. S. Skinner 21/11/11). In summary, the greatest weed threat to the area is from exotic woody weeds (e.g. elms, prunus, poplars, privet, pyracantha), and the invasive annual and biennial weeds that thrive in moist alluvial soils of flood-runners.

COMMON NAME	SCIENTIFIC NAME
Alligator weed	<i>Alternanthera philoxeroides</i>
Athel pine (athel tree)	<i>Tamaris aphylla</i>
Barley grass	<i>Hordeum spp.</i>
Bitou bush & boneseed	<i>Chrysanthemoides monilifera</i> & <i>Chrysanthemoides monilifera sub. Sp. monilifera</i>
Black alder	<i>Alnus glutinosa</i>
Black knopweed	<i>Centaurea nigra</i>
Black wattle	<i>Acacia decurrens</i>
Box elder maple	<i>Acer negundo</i>
Bracelet honey-myrtle	<i>Melaleuca armillaris</i>
Bracken	<i>Pteridium Esculentum</i>
Bridal creeper	<i>Asparagus asparagoides</i>
Broad-kernel espartillo	<i>Achnatherum caudatum</i>
Broomrapes	<i>Orobache spp. (except the native O. cernua var australiana and O. minor)</i>
Buffalo burr	<i>Solanum rostratum</i>
Cabomba	<i>Cabomba caroliniana</i>
Caltrop	<i>Tribulus terrestris</i>
Capeweed	<i>Arctotheca calendula</i>
Chinese violet	<i>Asystasia gangetica (subspecies mircantha)</i>
Coastal wattle	<i>Acacia longifolia var sophorae</i>
Coolatai grass	<i>Hyparrhenia hirta</i>
Cotoneaster (grey, large-leaf, silver leaf, willow-leaf, Himalayan)	<i>Cotoneaster spp. (franchetii, glaucophyllus, pannosus, salicifolius, simonsii)</i>
Devil's Claw	<i>Ibicella lutea/Probosidea louisianica</i>
Docks	<i>Rumex spp.</i>
Dodder	<i>Cuscuata spp. (except native spp.)</i>
East Indian hygrophila	<i>Hygrophila polysperma</i>
English & Chinese elms	<i>Ulmus spp.</i>
English Ivy	<i>Hedera helix</i>
Eurasian water milfoil	<i>Myriophyllum spicatum</i>
Fat hen	<i>Chenopodium album</i>
Fennel	<i>Foeniculum vulgare</i>
Firethorn/pyracantha (& scarlet firethorn)	<i>Pyracantha spp. (angustifolia, fortuneana & coccinea)</i>
Great mullein	<i>Verbascum Thapsus</i>

Green cestrum	<i>Cestrum parqui</i>
Guildford grass, onion grass	<i>Romulea rosea</i>
Hawkweek	<i>Hieracium app.</i>
Hemlock	<i>Conium maculatum</i>
Horsetail	<i>Equisetum spp.</i>
Hymenachne	<i>Hymenachne amplexicaulis</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
Johnson grass	<i>Sorghum halepense</i>
Karoo thorn	<i>Acacia karroo</i>
Kochia	<i>Bassia scoparia/Kochia scoparia</i>
Lagarosiphon	<i>Lagarosiphon major</i>
Lantana	<i>Lantana camara</i>
Lobed needle grass	<i>Nassella charruana</i>
Longstyle feather grass	<i>Pennisetum villosum</i>
Mesquite	<i>Prosopis spp.</i>
Mexican feather grass	<i>Nassella tenuissima Stipa tenuissima</i>
Miconia	<i>Miconia spp.</i>
Mimosa	<i>Mimosa pigra</i>
Mount Morgan wattle/Queensland silver wattle	<i>Acacia podalyriifolia</i>
Nettle tree	<i>Celtis australis</i>
Pampas grass (pink & common)	<i>Cortaderia spp. (jubata & selloana)</i>
Parkinsonia	<i>Parkinsonia aculeate</i>
Parrot's feather	<i>Myriophyllum aquaticum</i>
Parthenium weed	<i>Parthenium hysterophorus</i>
Perennial Canada thistle	<i>Cirsium arvense</i>
Periwinkle/blue periwinkle	<i>Vinca major</i>
Pond apple	<i>Annona glabra</i>
Poplars, Lombardy, Canadian and others	<i>Populus spp.</i>
Prairie ground cherry	<i>Physalis viscosa/physalis virginiana</i>
Prickly acacia	<i>Acacia nilotica</i>
Prickly pears	<i>Opuntia & Cyllindropuntia spp.</i>
Privet	<i>Ligustrum lucidum, L. Sinense and L. Vulgare</i>
Purpletop	<i>Verbena spp.</i>
Pyracantha	<i>Angustifolia & related spp.</i>
Ragwort	<i>Senecio jacobaea</i>
Rosemary grevillea	<i>Cryptospegia grandiflora</i>
Rubber vine	<i>Cryptostegia grandiflora</i>
Saffron thistle	<i>Carthamus lanatus</i>
Salvinia	<i>Salvinia molesta</i>
Senegal tea plant	<i>Gymnocoronis spilanthoides</i>
Service tree, rowan	<i>Sorbus spp. (domestica and aucuparia)</i>
Siam weed	<i>Chromolaena odorata</i>
Sifton bust	<i>Cassiania accuata</i>

Silverleaf nightshade	<i>Solanum elaeagnifolium</i>
Slender thistle	<i>Carduus spp. (pycnocephalus & tenuiflorus)</i>
Snowy River wattle	<i>Acacia boormanii</i>
Sorrel	<i>Rumex acetosella</i>
Spanish broom	<i>Spartium junceum</i>
Spear thistle	<i>Spartium vulgare</i>
Spiny burrgrass	<i>Cenchrus incertus/Cenchrus longispinus</i>
Spotted knapweed	<i>Centaurea maculosa</i>
Storksbill, wild geranium	<i>Erodium spp.</i>
Thornapple	<i>Datura spp.</i>
Vulpia	<i>Vulpia spp.</i>
Water caltrop	<i>Trapa spp.</i>
Water hyacinth (& anchored water hyacinth)	<i>Eichhornia spp. (crassipes & azurea)</i>
Water lettuce	<i>Pistia stratiotes</i>
Water soldier	<i>Stratiotes aloides</i>
White Sally wattle	<i>Acacia floribunda</i>
Wild Plums	<i>Prunus spp.</i>
Wild radish	<i>Raphanus raphanistrum</i>
Willow-leaved hakea	<i>Hakea salicifolia</i>
Wireweed	<i>Polygonum aviculare</i>
Witchweed	<i>Striga spp. (except native spp & Striga parviflora)</i>
Yellow bamboo	<i>Phyllostachys aurea</i>
Yellow burrhead	<i>Limnocharis flava</i>
Yorshire fog	<i>Holcus lanatus</i>

Priority Weeds List

The Molonglo Catchment Priority Weeds List identifies 22 weeds that pose a significant threat to our local environment, as well as to agriculture and amenity. Many of these weeds are already widespread, whilst some of them have just begun moving into the catchment and pose a high risk of spreading further if left unchecked. The need for these weeds to be treated as priorities is indicated consistently in the existing federal, state, territory and regional weed lists.

The list was developed through consultation with local weed experts including Council weed officers, staff from Parks, Conservation and Lands ACT and the Murrumbidgee Catchment Management Authority (CMA), and community volunteers with long term experience in weed management.

The list is accurate in identifying species that are a priority for control due to their invasiveness, impacts and ability to spread. It is presented in alphabetical order for ease of reference. When planning weed management on your property, you may wish to conduct a formal prioritisation process in order to ensure that you direct your efforts towards the highest priority species on your individual patch of land.

The following list has been compiled by the Molonglo Catchment Group. Refer to the 'Regional Weed Strategy – Murrumbidgee Catchment' Published by the Murrumbidgee CMA, for a simple and easy to use prioritisation process.

African boxthorn
African lovegrass
Blackberry
Broom (Cape/Montpellier & Scotch/English)
Burrs (Noogoora & Bathurst)
Chilean needle grass
Cootamundra wattle
False acacia/black locust
Fireweed
Gorse
Hawthorn
Horehound
Paterson's curse and viper's
Bugloss
Poplars (white & Lombardy)
Privet
Radiata/Monterey pines
Serrated tussock
St. John's wort
Sweet briar/briar rose
Thistles (Scotch, Illyrian & nodding)
Tree of heaven
Willows (except weeping willow and two types of sterile pussy willow)

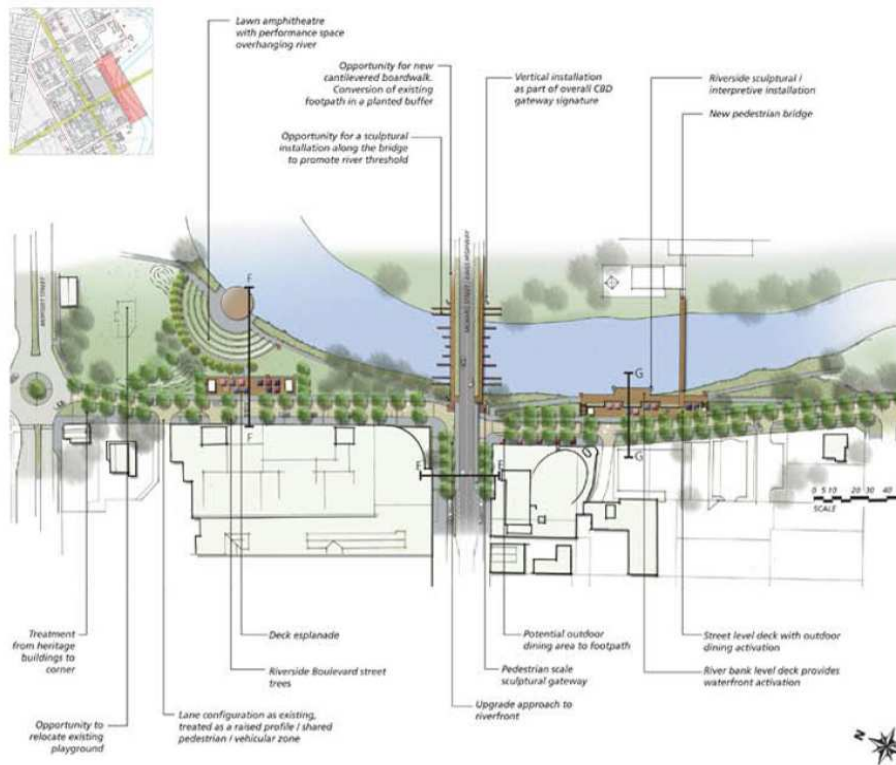
Appendix J: Species suitable for revegetation

The following list of species that are considered suitable for use in revegetation of the Queanbeyan river riparian zone.

VEGETATION TYPE	SCIENTIFIC NAME	COMMON NAME
Trees	<i>Casuarina cunninghamiana</i>	River She Oak
	<i>Eucalyptus blakelyi</i>	Blakely's Red Gum
	<i>Eucalyptus bridgesiana</i>	Apple Box
	<i>Eucalyptus mellidora</i>	Yellow Box
	<i>Eucalyptus pauciflora</i>	White Sally
	<i>Eucalyptus viminalis</i> (probably dominant)	Ribbon Gum
	<i>Brachychiton populneus</i>	Kurrajong
Shrubs	<i>Acacia dealbata</i>	Silver Wattle
	<i>Acacia parramattensis</i>	Parramatta Wattle
	<i>Acacia Mearnsii</i>	Green Wattle
	<i>Acacia rubida</i>	Red-stemmed Wattle
	<i>Bursaria spinosa</i>	Sweet Bursaria (Australian Blackthorn)
	<i>Callistemon sieberi</i>	River (or Swamp) bottlebrush
	<i>Cassinia quinquefolia</i>	Cough Bush
	<i>Clematis microphylla</i>	Small-leaved Clematis
	<i>Gynatrix pulchella</i>	Hempbush
	<i>Hakea microcarpa</i>	Small-fruited Hakea
	<i>Indigofera australis</i>	Austral Indigo
Ground covers	<i>Austrodanthonia spp.</i>	Wallaby Grass
	<i>Austrostipa scabra</i>	Speargrass
	<i>Bubine bulbosa</i>	Bulbine Lily
	<i>Carex appressia</i>	Tall sedge
	<i>Chrysocephalum apiculatum</i>	Yellow Buttons
	<i>Chrysocephalum semipapposum</i>	Clustered Everlasting
	<i>Dianella longifolia</i>	Flax Lily
	<i>Hardenbergia violacea</i>	False Sarsparilla
	<i>Lepidosperma laterale</i>	Variable Sword-sedge
	<i>Lomandra longifolia</i>	Spiny Mat-rush
	<i>Microlaena stipoides</i>	Weeping Grass
	<i>Pennisetum alopecuroides</i>	Swamp Foxtail
	<i>Phragmites australis</i>	Common Reed
	<i>Poa labillardieri</i>	Tussock Grass

VEGETATION TYPE	SCIENTIFIC NAME	COMMON NAME
	<i>Ranunculus papulentus</i>	Buttercup
	<i>Stackhousia monogyna</i>	Creamy Candles
	<i>Themeda australis</i>	Kangaroo Grass
	<i>Thysanotus tuberosus</i>	Fringed Lily
	<i>Typha spp.</i>	Bulrush
	<i>Rubus parvifolius</i>	Native Raspberry
	<i>Wurmbea dioica</i>	Early Nancy

Appendix K: Relevant actions from the CBD Master Plan (Place 2009)



Collett St Riverside

Plan

Collett Street would be upgraded to create an activated and vibrant CBD riverfront. Treated as a shared pedestrian/vehicular zone with a raised road profile, feature road surface and street tree planting, Collett St. would invite the activation of the riverfront with more pedestrian friendly conditions.

The adjacent Park developments could include raised and river level boardwalks, an informal amphitheater / performance space and new, footpaths.

The crossings of the river could be further developed, with a new pedestrian bridge and the integration of a cantilevered boardwalk along Kings Hwy.

To emphasize the importance of this threshold, architectural treatments to the bridge and gateway elements would be key components of the interventions.

View South Along Collett Street

The activation of Collett St. and adjacent parklands can also engage the river in a more direct way, by creating a new pedestrian crossing of the river and creating active spaces in a closer proximity to the river. Raised and river level boardwalks give the opportunity to create beer gardens or similar outdoor dining experiences.

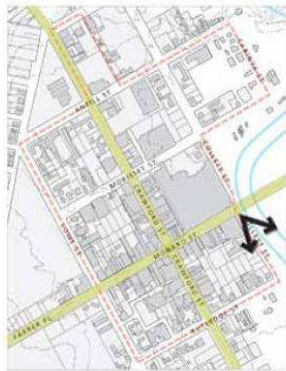
This active node would also enhance the arrival to the river along the cultural spine that links the Queanbeyan Performing Arts Centre.

Opportunities to create artistic, interpretative and recreational exploration routes of the river front and CBD would have in these areas an ideal setting.

Both the riparian corridor and the urban frontage would benefit from additional planting as well as to helping to create a more ecological feel within the context of the urban activation development.



Existing conditions



Artist impression of proposed conditions

**HEAD OFFICE**

Suite 4, Level 1
2-4 Merton Street
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

SYDNEY

Level 6
299 Sussex Street
Sydney NSW 2000
T 02 9993 0566
F 02 9993 0573

ST GEORGES BASIN

8/128 Island Point Road
St Georges Basin NSW 2540
T 02 4443 5555
F 02 4443 6655

CANBERRA

Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 6103 0148

HUNTER

Suite 17, Level 4
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 4910 0126

NAROOMA

5/20 Canty Street
Narooma NSW 2546
T 02 4476 1151
F 02 4476 1161

COFFS HARBOUR

35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

ARMIDALE

92 Taylor Street
Armidale NSW 2350
T 02 8081 2681
F 02 6772 1279

BRISBANE

93 Boundary St
West End QLD 4101
T 1300 646 131

WESTERN AUSTRALIA

3/29 Ord Street
West Perth WA 6005
T 08 9227 1070
F 08 9324 3538

WOLLONGONG

Level 2
25 Atchison Street
Wollongong NSW 2500
T 02 8536 8615
F 02 4254 6699

GOSFORD

Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1220
F 02 4322 2897