REFRESHING
UPPER BILLABONG
Waterway Management Plan
April 2023

NSW GOVERNMENT
refreshing rivers
Holbrook Landcare Network
YACTAC
Riverina Highlands Landcare Network
Griffith UNIVERSITY
Social Marketing @ Griffith

Acknowledgement of Country

The Upper Billabong catchment was, and always will be Wiradjuri country and we would like to acknowledge the Traditional Custodians of the land, and members of other nations on this land on which they live and work and recognise their continuing connection to land, water and community.

In Wiradjuri language,

kaarray binaal billas
Land of many rivers

ngangaana kaarray billas
Look after the land and rivers

dya, kaarray billas
darraay ngangaana ngindu
And the land and rivers will look after you

(*Upper Billabong Land and Water management Plan in 2001, Pastor Cec Grant*)

The project team gratefully acknowledges Traditional Custodians, the Upper Billabong community, the Target Area Advisory Group (TAAG) and workshop attendees for their valuable contributions to the development of this draft report.

refreshing
rivers
Upper Billabong

Contents

1 Introduction

The Upper Billabong catchment has a leading Landcare Network that has worked for 30 years in the region to improve land and productivity on farms. In 1996, the Holbrook community decided to develop the Upper Billabong Land and Water Management Plan (UBLWMP), in response to concern over salinity and land degradation and a need for a more coordinated approach.

The Plan process took three years and was released in 2001. It included the following 30-year vision for the catchment:

"To improve the economic, social and physical environment of the Upper Billabong Catchment by the implementation of a viable Land and Water Management Plan through education, participation and community ownership."

This current project is a community-led plan which includes:

- progress on the UBLWMP in relation to catchment and waterway health
- communities' values around waterways now
- threats to those values and the key assets within them
- actions to address the threats and protect values
- objectives for the values and assets
- indicators to monitor progress against objectives.

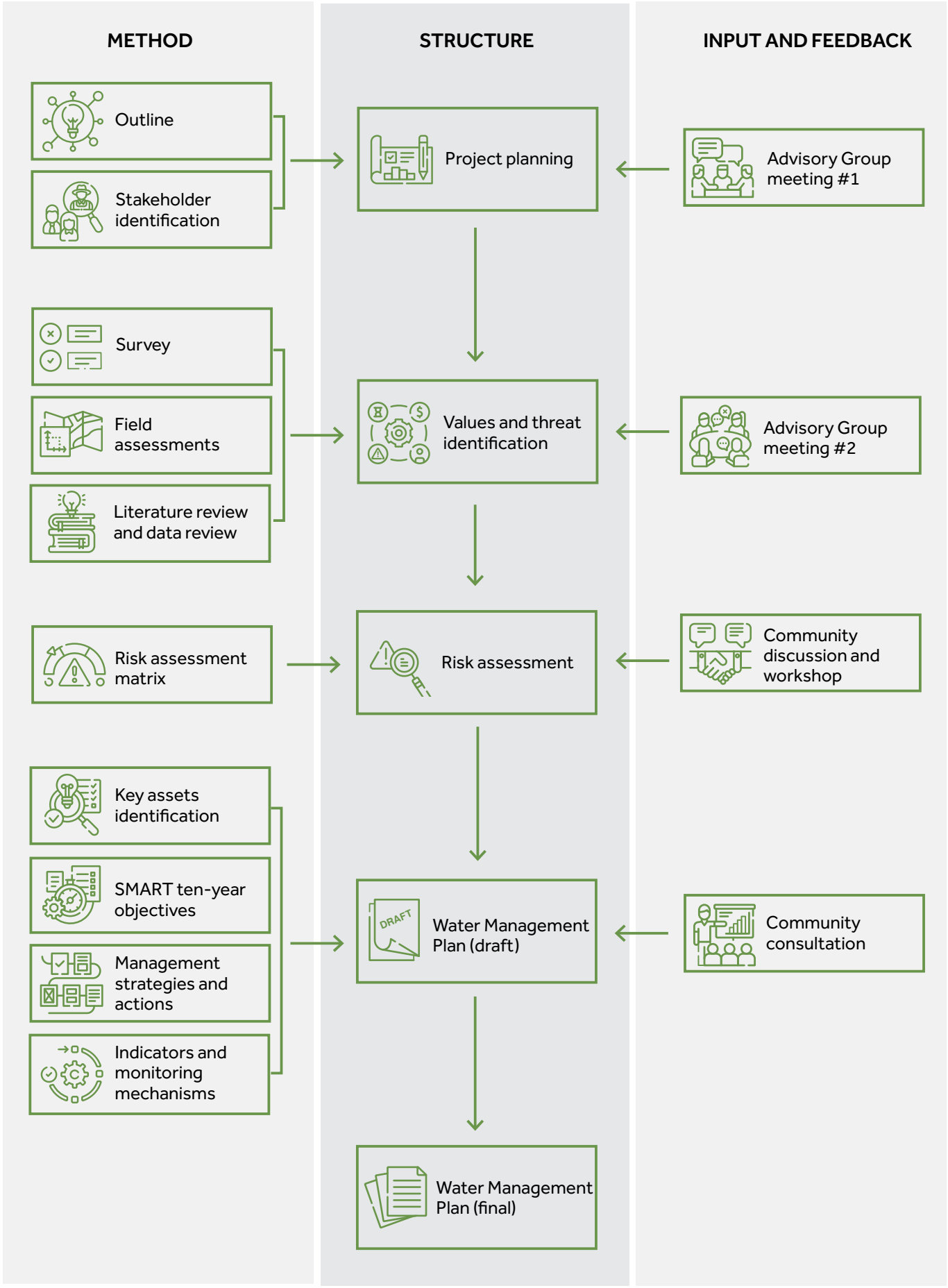
The outcomes of the Waterway Management Plan over the next ten years, will be:

- Improved riparian and catchment land management, and river health in the Upper Billabong catchment driven by a strategic, integrated plan.
- A consistent, tested, yet flexible, process for the development of Waterway Management Plans in NSW, leading to broader state-wide river health assessments.

Consultation for the Waterway Management Plan was conducted throughout 2022 in collaboration with the Target Area Advisory Group (TAAG) for the Upper Billabong region, surveys and in-person meetings with the wider community. See the figure on the following page for the stepwise approach to the development of the Plan.

Above: Thugga Thugga swamp. Credit: Kylie Durant, Holbrook Landcare Network.

CONSULTATION PROCESS



Above: Community discussion around waterway actions in Holbrook, November 2022.

Above: Local students create a campaign to improve waterway health in Holbrook, November 2022.

2 Project area and environment

The Upper Billabong Catchment lies on the eastern part of the Murray-Riverina Region of New South Wales (NSW), 50 kilometres north-west of Albury. It is entirely within the Greater Hume Council area, after the amalgamation of Holbrook and Culcairn Shire Council areas in 2004. The Upper Billabong catchment covers an area of 171,000 hectares and is located in the headwaters of the Billabong Creek, which stretches west, over 300km and is believed to be one of the longest creeks in the world (Greater Hume Council 2023).

The Upper Billabong is and always will be Wiradjuri Country. Holbrook was a gathering place where people gathered before travelling south to Mulyan Yandera (Tabletop Mountain) for ceremony (Lindsay 'Blar' Connolly, Uncle Jimmy Ingram and Alice Williams 2014).

The landscape history is similar to other sheep and wheatbelt areas of Australia with cycles of clearing and the gradual intensification of agricultural practices, rabbit plagues and then the introduction of exotic pasture grasses and superphosphate. Although largely a farming landscape, remnant native vegetation, Threatened fauna and habitats are present in the catchment. The largest areas of remnant vegetation tend to be linear corridors along waterways, roadsides and fence lines; as well as in public land such as in the Woomargama National Park and Benambra Nature Reserve.

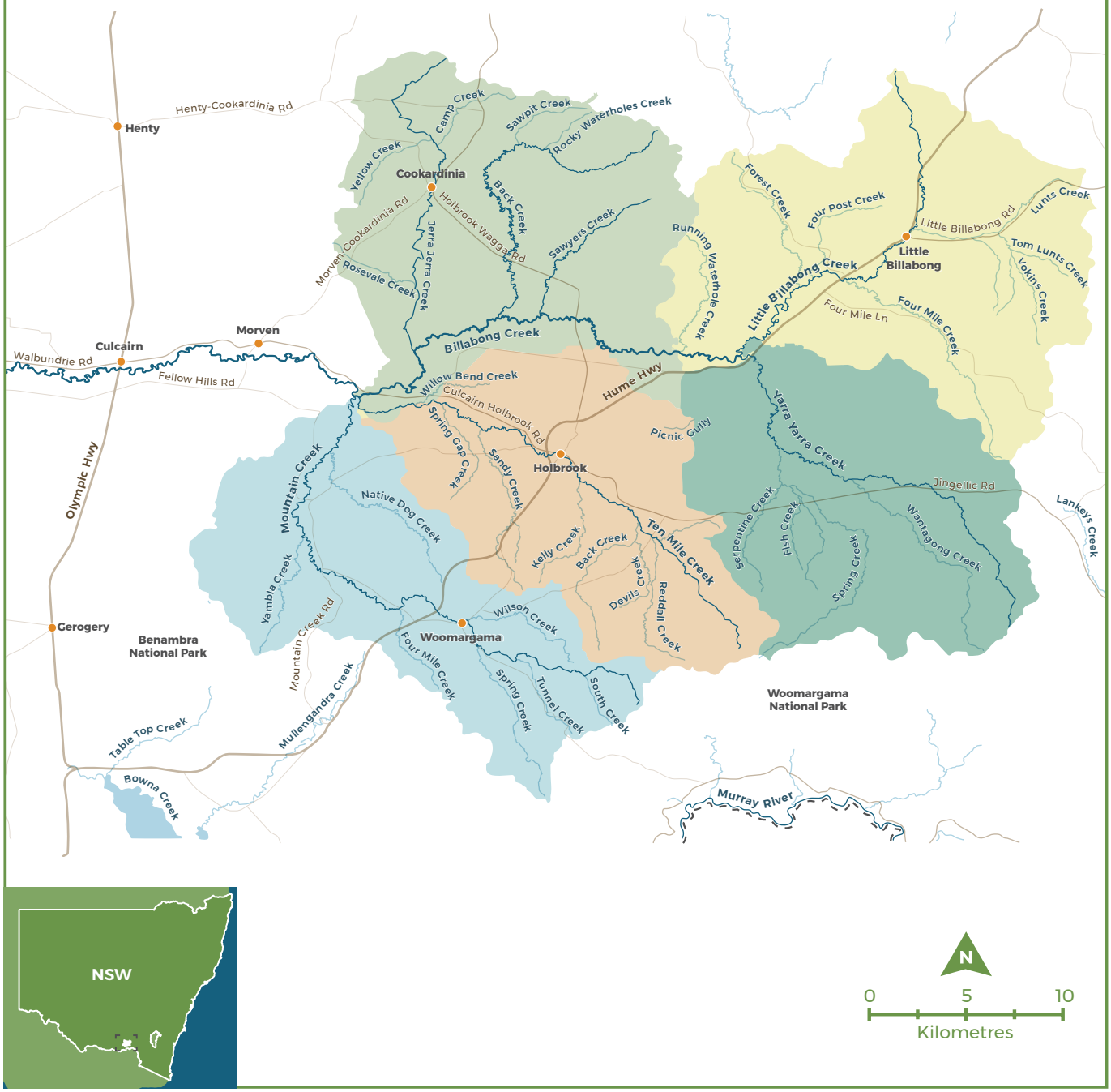
The Upper Billabong is an unregulated system – there are no in-stream storages, which means it flows in response to rainfall conditions and is completely reliant on rainfall and groundwater for flow. Except for the very top of the tributaries that rise in the ranges at the east of the catchment, the waterway systems are largely laterally unconfined systems flowing through previously deposited sediments, which means the channels can change readily in response to high flow events and bed and bank erosion is common.

The Upper Billabong has had a long history of the Landcare ethos and being leading producers adopting new practices and management techniques. It's estimated that $4.8M dollars have been invested in on-ground action through Holbrook Landcare in the Upper Billabong since 1990 (HLN available data analysis 2023). Assuming at least a cost share of 50% with landholders, it is estimated that over $10M of works have been completed in the catchment.

SUB-CATCHMENTS AND WATERWAYS

The Upper Billabong catchment is made up of five sub-catchments (See map on following page). Considerable environmental works have been conducted across all sub-catchments as detailed in Section 3.

UPPER BILLABONG



KEY

Sub-catchments

- Jerra Jerra/Sawyers/ Back Creek
- Little Billabong Creek
- Mountain Creek
- Ten Mile Creek
- Yarra Yarra/ Upper Wantagong Creeks

- Main waterway
- Tributary
- Road
- Town
- State border

3 Progress on the Upper Billabong Land and Water Management Plan (UBLWMP)

The UBLWMP included many actions and targets. Systematic monitoring of the indicators for the UBLWMP did not occur and investment was often driven by other policy instruments and influenced by machinery of government changes, rather than the plan. Around 2004, the funding model for Natural Resource Management (NRM) changed in NSW and the Catchment Management Authorities (CMAs) implemented on-ground activity directly with landholders. At this time, Landcare had no access to grant funding.

However, on-ground work, such as *revegetation* and *improved management of remnant native vegetation* did progress and is represented in Table 1. Other targets are represented through HLN programs such as Acid Soil Management.

Catchment	Creek Length (km)	Total Works Length (km)	Percentage of Creek Length Protected
SUB-CATCHMENTS			
Jerra Jerra / Sawyers / Back Creeks	140	31	22%
Little Billabong Creek	145	24	17%
Mountain Creek	120	36	30%
Ten Mile Creek	123	36	29%
Yarra Yarra / Wantagong Creeks	108	18	17%
WHOLE OF CATCHMENT			
Upper Billabong Creek Catchment	636	145	23%

Table 1: On-ground works (fencing, revegetation) conducted in the catchment from 2001 to 2023.

4 Vision

The Waterway Management Plan uses information on the community's vision for the catchment, what they value, and threats to those values, to develop targeted management actions. Information on the vision, values and threats in the region were collated using the community survey, in-person discussions, site visits, input from Holbrook Landcare Network and a review of legislation, literature and other data.

In the survey, respondents were presented with the vision developed as part of the Upper Billabong Land and Water Management Plan in 2001:

"*To improve the economic, social and physical environment of the Upper Billabong Catchment by the implementation of a viable Land and Water Management Plan through education, participation and community ownership*"
(Upper Billabong Land and Water Management Plan, 2001).

Respondents were asked:

Is there anything you would change about this vision, for the refreshed Waterway Management Plan?

Responses are summarised in Figure 1 below:

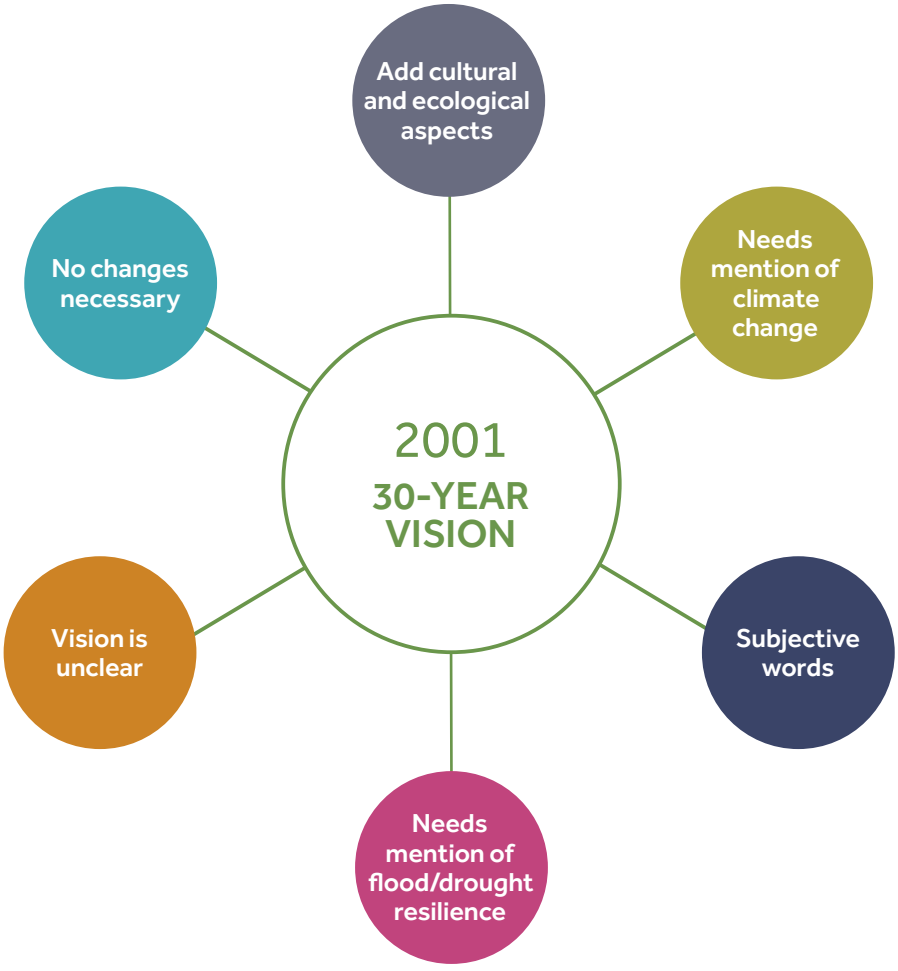


Figure 1: Changes to vison for the Upper Billabong Waterway Management Plan.

Respondents were also asked:

How would you like the Upper Billabong catchment to be, feel or look in 30 years' time?

Topics such as biodiversity, clean water and waterways, agriculture, healthy landscapes, flood control and less erosion featured heavily in the text responses. See the word cloud in Figure 2 below.

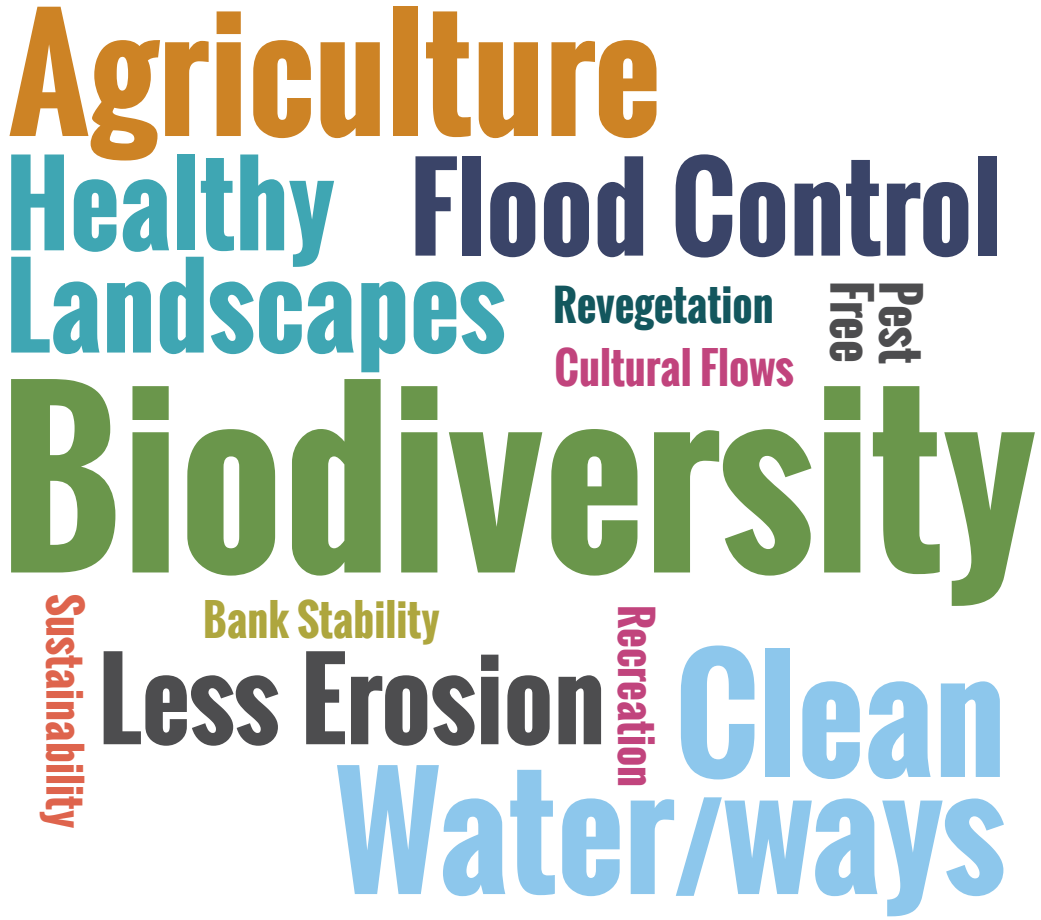


Figure 2: Thirty-year community vision for Upper Billabong.

5 Values

In the survey, 12 values were listed, and respondents were asked to rank these values in terms of their importance . The survey results are summarised in Figure 3 below.

The plan has taken the values identifed by the community and set out objectives to ensure the assets are protected and enhanced for the future.

KEY VALUES OF OUR WATERWAYS

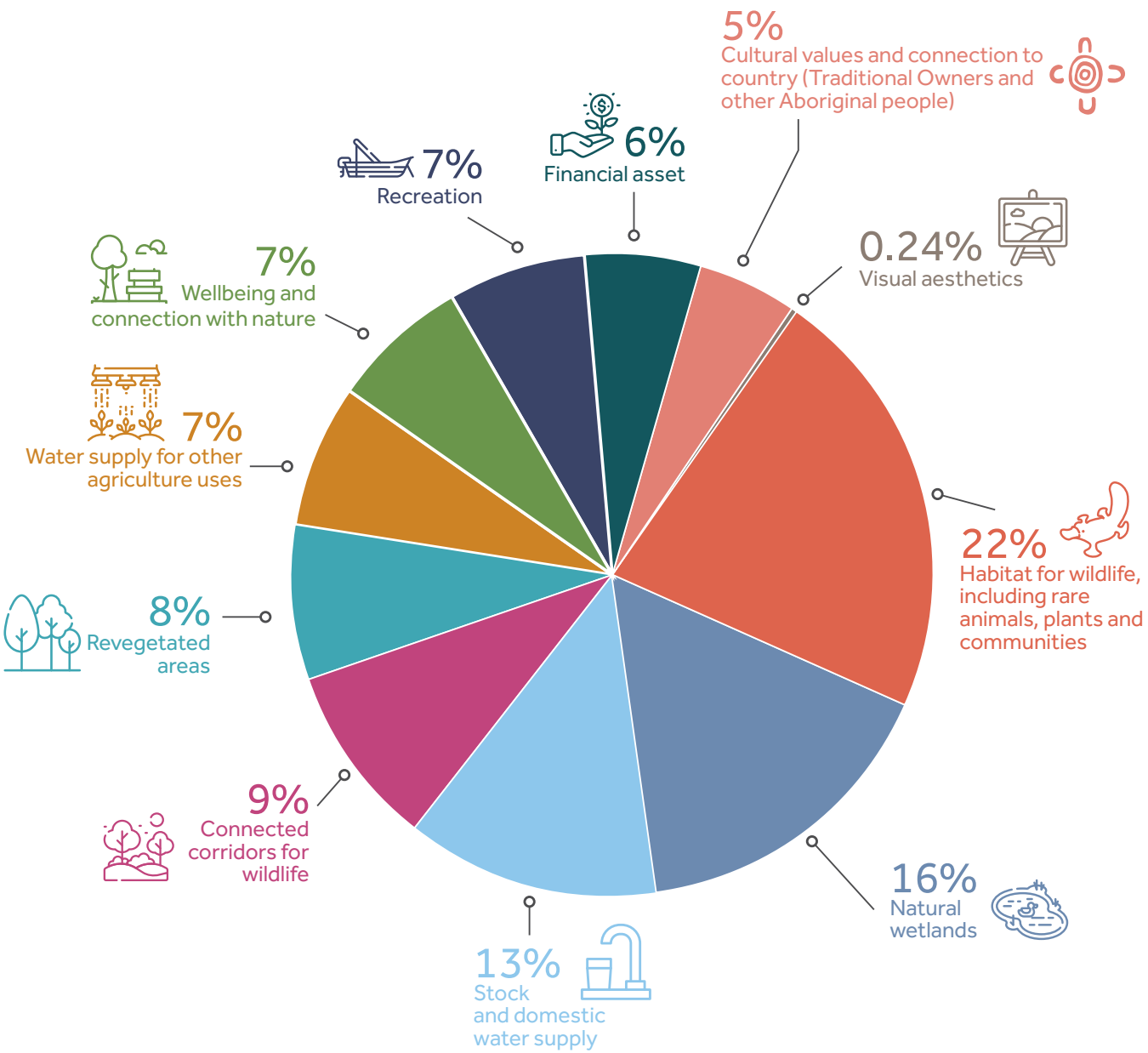


Figure 3: Values of the Upper Billabong waterways as voted by the local community.

5.1 HABITAT FOR WILDLIFE, INCLUDING RARE ANIMALS, PLANTS AND COMMUNITIES

Habitat for wildlife, including rare animals was the highest rated value according to the Upper Billabong community survey. The key pieces of legislation that identify and protect threatened species, populations and ecological communities in NSW are the *Biodiversity Conservation Act 2016* (BC Act) which generally covers terrestrial and semi aquatic species such as mammals, reptiles, birds and amphibians; and the *Fisheries Management Act 1994* which covers fish.

Several rare and Threatened species and their habitats in the catchment will be the focus of actions over the next ten years. These include:

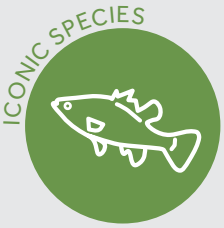
- Southern Pygmy Perch
- Mountain Galaxias
- Freshwater Mussels
- Refuge pools.

Above: Refuge pool at Spring Creek, Narra Narra. Credit: Rob Lacey.

Southern Pygmy Perch

Southern Pygmy Perch (*Nannoperca australis*) is Endangered in NSW and formerly found in the Murray and lower Murrumbidgee River systems but have experienced large-scale reductions in their range since European settlement. Threats to the species in the Upper Billabong include alien fish (carp, redfin and gambusia), sedimentation, loss of refuge pools and habitat loss. Works have commenced in the Upper Billabong catchment to map and restore habitats for Southern Pygmy Perch,and reduce threats to the species.

Above: Southern Pygmy Perch. Credit: NSW Dept Planning & Environment



ASPIRATIONAL GOAL

Secured a viable local population of Southern Pygmy Perch in a range of habitats and locations across the catchment.

OBJECTIVES FOR THIS ASSET

By 2024:

- Continued to work with stakeholders to monitor the distribution and abundance of Southern Pygmy Perch and its habitats.

By 2026:

- Used monitoring results to prioritise locations to enhance and protect key habitats for Southern Pygmy Perch to maintain existing populations.
- Implemented on-ground works to enhance and protect habitat for Southern Pygmy Perch in priority reaches.
- Supported investigations into genetic management of Southern Pygmy Perch to inform actions to maintain genetic diversity and adaptability in the future, to assist the long-term survival of populations.
- Worked with landholders to establish refuge populations of Southern Pygmy Perch in farm dams.

By 2031:

- Implemented in-stream works such as strategic wood placement and sediment excavation (as appropriate); and riparian protection and improvement works such as fencing, revegetation and woody weed control to enhance and protect habitat for Southern Pygmy Perch in priority reaches.
- Enhanced and protected key habitats to extend the distribution of Southern Pygmy populations.

Mountain Galaxias

Mountain Galaxias (*Galaxias olidus*) (also known as Ornate Mountain galaxias) although not listed, is declining in abundance throughout its range in south-eastern Australia. There is one record of Mountain Galaxias in the upper Billabong catchment, and it is of local significance. It was observed in refuge pools at the top of Reddals Creek in the Woomargama National Park in 2013, highlighting the importance of these pools during droughts. One of the key threats to this species is Trout, and may be restricted to very shallow edge habitats where trout are abundant. They are often only found above waterfalls or swamps that prevent trout access.

Above: Mountain Galaxias. Credit: NSW Fisheries.

ASPIRATIONAL GOAL

To have secured local population/s of Mountain Galaxias.

OBJECTIVES FOR THIS ASSET

By 2024:

- Worked with stakeholders to confirm and monitor the presence and abundance of Mountain Galaxias.

By 2026:

- Identified actions that may be required to maintain the population of Mountain Galaxias.

By 2031:

- Implemented on-ground works to enhance and protect habitat for Mountain Galaxias in priority reaches (where required).

Freshwater Mussels

Freshwater mussels (*Hyridella* sp.) are present in some of the waterways in the catchment. They are sensitive to habitat degradation and can be important indicators of waterway health. Freshwater mussels live on bottoms of streams and lakes so stream bed stability with dense vegetation and woody debris is their preferred habitat. Mussels filter large volumes of water to extract their food, removing nutrients, algae, bacteria and organic detritus from the water. Threats to the freshwater mussel include removal of vegetation, sedimentation, stream erosion, water pollution from runoff.

Above: Freshwater mussels. Credit: Luke Pearce, Dept of Primary Industries - Fisheries.

ASPIRATIONAL GOAL

Secured local population/s of Freshwater mussels.

OBJECTIVES FOR THIS ASSET

By 2024:

- Worked with stakeholders to promote the presence and importance of Freshwater mussels to the community.

By 2026:

- Implemented on-ground works to enhance and protect habitat for Freshwater mussels around waterways and farm dams.

By 2031:

- Continued to implement on-ground works to enhance and protect habitat for Freshwater mussels around waterways and farm dams.
- Worked with First Nations People to explore the Cultural significance of Freshwater mussels, and in the management and monitoring of the species.

Refuge pools

Refuge pools are habitat features that support the long-term survival of Threatened and iconic species in the catchment. The impacts of climate change, such as drought, can remove habitat areas that biota normally use and they can become restricted to isolated 'refuge habitats'. These may include riverine pools, waterholes or floodplain lagoons. Elements of habitat such as logs, wet patches under-banks, riffles, streambed sediments, yabby holes and riverside or riverbed vegetation may also provide refuge habitat (EWater CRC 2023).

Above: Refuge pool at Four Mile Creek, Yallock. Credit: Kylie Durant.

ASPIRATIONAL GOALS

- Better understand the presence and distribution of threatened and iconic species in the catchment.
- Secured refuge pools in the catchment for threatened and iconic species.
- Ensure that all refuge pool habitat is protected and key threats are managed in the catchment.

OBJECTIVES FOR THIS ASSET

By 2024:

- Investigated options to expand or establish survey and monitoring for threatened and iconic species such as Rakali, Sloane's Froglet and native fish.
- Identified high value refugia for iconic and threatened species such as Rakali, Sloane's Froglet and native fish.

By 2026:

- Expanded or established survey and monitoring for threatened and iconic species such as Rakali, Sloane's Froglet and native fish.
- Prioritised rehabilitation of at least two sites per sub-catchment (or more if appropriate) with a target species in mind.

By 2031:

- Improved understanding of threatened and iconic species in the catchment such as Rakali, Sloane's Froglet and native fish.
- Implemented on-ground works at (at least) two sites per sub-catchment (or more if appropriate) to enhance and protect high value refugia for target species.

5.2 NATURAL WETLANDS

Natural wetlands, such as billabongs, soaks, swamps and seasonally wet areas, was the second highest rated value according to the survey results.

Wetlands provide habitat for native animals including waterbirds, fish, frogs and invertebrates and plants; and breeding grounds and nurseries for fauna, particularly insects, fish, frogs and waterbirds. Many of these species are listed threatened species and ecological communities (DECCW 2010).

Above: Floodplain wetland on Billabong Creek at Bellvue. Credit: Kylie Durant

High conservation wetlands

High conservation wetlands in the catchment that have retained 30-70% (or more) of their native vegetation and Seasonal Herbaceous Wetlands (Critically Endangered under the EPBC Act).

ASPIRATIONAL GOAL

To have mapped and protected all high conservation wetlands.

OBJECTIVES FOR THIS ASSET

By 2024:

- Worked with agency stakeholders to understand climate change impacts on local wetlands, and prioritise wetlands in the catchment for monitoring and management.
- Initiated an awareness raising campaign with agency stakeholders and landholders about different types of wetlands in the catchment, their importance and the ecosystem services that they provide.

By 2026:

- Worked with agency stakeholders to protect two high conservation wetlands on public land.
- Raised awareness with agency stakeholders and landholders about different types of wetlands in the catchment, their importance, the ecosystem services that they provide, and how they could be monitored.

By 2031:

- Worked with agency stakeholders and landholders to protect ten high conservation wetlands on public or private land.

5.3 STOCK AND DOMESTIC WATER SUPPLY

Stock and domestic water supply was the third greatest value in the catchment according to the survey results. Words such as '*clean water*'; '*cleaner, less degraded waterways*'; and '*fresh clean waterways filled with water plants and reeds and lined with grasses, scrub and trees and bugs, fish and frogs reptiles…solid biodiversity and healthy produce from farms*' were used in survey responses which demonstrate the value of water supply and quality to the community.

Many people in the catchment extract water from their local waterways for domestic use. In addition, local government authorities extract, treat and distribute water for town water supply.

Above: Sheep paddock. Credit Rob Lacey.

ASPIRATIONAL GOAL

To have improved and maintained water quality at key locations since baseline was established in 2024.

OBJECTIVES FOR THIS ASSET

By 2024:

- Initiated a community campaign about water quality in the catchment, to further understand perceptions of 'water quality' decline and communicate information on impacts to water quality and how they can be mitigated.
- Worked with agency stakeholders to access existing water quality monitoring results and expanding the monitoring network at key locations.
- Initiated work with agency stakeholders, researchers and landholders to further understand the effectiveness of local interventions on turbidity in the catchment.

By 2026:

- Created opportunities for the broader community, including school children, to be involved in citizen science water quality monitoring.
- Worked with agency stakeholders and the community to install devices, systems or products to expand the monitoring network at key locations.
- Improved understanding of the effectiveness of local interventions on turbidity in the catchment.
- Worked with agency stakeholders and landholders to facilitate erosion management, stock exclusion and revegetation (particularly early intervention) along waterways to contribute to water quality improvements.
- Promote information on the benefits of clean water to livestock health and productivity to landholders by restricting stock access to waterways.
- Supported and initiated programs that address fertiliser efficiency, on-farm water efficiency and quality improvement.
- Encouraged on-farm stock water quality monitoring (e.g. in dams and troughs) and research on the production penalties/benefits of water quality for stock.

By 2031:

- Improved water quality by 5% at key locations in the catchment.
- Worked with landholders to facilitate 17 activities to address point source pollution, such as erosion management, stock exclusion and revegetation, to contribute to water quality improvements.
- Increased landholder participation in existing programs which help to improve water quality.
- For the broader community to be actively involved in water quality monitoring.

5.4 CONNECTED CORRIDORS FOR WILDLIFE

Connected corridors for wildlife was ranked as the fourth highest value in the catchment in the survey. Biodiversity was the most commonly used word in the '30 year vision', indicating that respondents see it as a key component of the future management of the catchment.

There have been significant investments in connectivity conservation in the past 15 years and protection and establishment of riparian vegetation has been a priority for site selection for funding due to it being in the most fertile and productive parts of the landscape with natural connectivity values that can be enhanced.

Key assets include:

- Public land with riparian corridors (e.g. TSRs, National Parks, Nature Reserves, other Crown land and Council reserves) in the catchment, including Woomargama Common and Ian Geddes Reserve.
- Vegetated riparian corridors and blocks of remnant vegetation within 1 km from waterways.

Above: Connected corridors. Credit: Rob Lacey.

ASPIRATIONAL GOAL

Improved the connectivity of patches of vegetation and improve linkages along and adjacent to waterways and wetlands in the catchment.

OBJECTIVES FOR THIS ASSET

By 2024:

- Prioritised areas of riparian vegetation in the catchment for protection, improvement and connection to other vegetated areas.

By 2026:

- Investigated options for biodiversity stewardship payments for protecting and improving vegetation corridors.
- Developed (or enhanced existing) partnerships with stakeholders, landholders and the broader community to work together on improving vegetation connectivity in the catchment.

By 2031:

- Protected vegetation and created linkages along and adjacent to waterways and wetlands, through 12 voluntary and non-binding conservation agreements.
- Regenerated 750 hectares of riparian land.

5.5 REVEGETATED AREAS

In the Upper Billabong catchment, significant work has been conducted over the past 30 years to revegetate the landscape, establishing connected corridors for wildlife. The Billabong Creek was described by wildlife ecologist Matt Herring in a study in 2002 as a "wildlife superhighway" - the Billabong Creek and it's tributaries, notably the Yarra Yarra, Jerra Jerra, Back Creek, Ten Mile Creek have numerous Squirrel Glider and Brown Treecreeper populations (Eastern Billabong Wildlife 2002).

Holbrook Landcare Network data indicates that approximately 23% of the catchment has been protected (generally through fencing and revegetation) over the past 30 years (not including headwater gullies).

Above: Revegetation in a fenced riparian area. Credit: Rob Lacey.

ASPIRATIONAL GOAL

Improved the condition of sites adjacent to waterways and wetlands in the catchment.

OBJECTIVES FOR THIS ASSET

By 2024:

- Adapted, as required, revegetation techniques based on previous experience in the catchment (i.e. what has worked and what hasn't).
- Continued to support Holbrook Landcare Network in the development of climate ready revegetation guides (including for riparian areas).
- Promoted opportunities for funding revegetation through natural capital market and incentive programs.
- Developed an improved data management system for revegetation (and other works) sites.

By 2026:

- Continued to work with stakeholders, landholders and the broader community to promote the benefits of revegetation, and options to maintain or establish revegetation (including through natural capital projects).
- Worked with landholders, stakeholders and the broader community to maintain existing revegetation, or establish new revegetation, through the initiation of land management plans.

By 2031:

- Developed 20 land management plans with landholders.
- Revegetated 750 hectares of land.
- Regenerated (through weed control/ fencing/ pest control/ in-stream works) 750 hectares of land.
- Actively working in partnership with stakeholder agencies, private landholders and the broader community to monitor the impact at the site scale, of riparian management (intervention) works, including revegetation.
- Included climate ready revegetation guidance into all land management plans.

5.6 CULTURAL VALUES AND CONNECTION TO COUNTRY (TRADITIONAL CUSTODIAN VALUES)

The Upper Billabong catchment is Wiradjuri Country, part of both the Albury and Wagga Wagga Land Council areas. There has been very limited engagement with First Nations People in the catchment to date. This is something that Holbrook Landcare Network is seeking to change, and improve during the Refreshing Rivers Program.

ASPIRATIONAL GOAL

Enriched, enhanced and fostered opportunities for First Nations People to connect with, to be on, and to continue to manage Country.

OBJECTIVES FOR THIS ASSET

By 2024:

- Made connections with First Nations People in the development of the Waterway Management Plan.

By 2026:

- Encouraged and created opportunities for First Nations People to engage with waterways and waterway management in the catchment. This includes for the protection of physical and spiritual cultural values, the management of environmental values, and connection to Country.

By 2031:

- Developed a partnership with First Nations People in the catchment, to enable First Nations People to connect with, to be on, and to continue to manage Country.

6 Threats

In the survey, 13 values were listed, and respondents were asked to rank these values in terms of their importance The survey results are summarised in Figure 3 below.

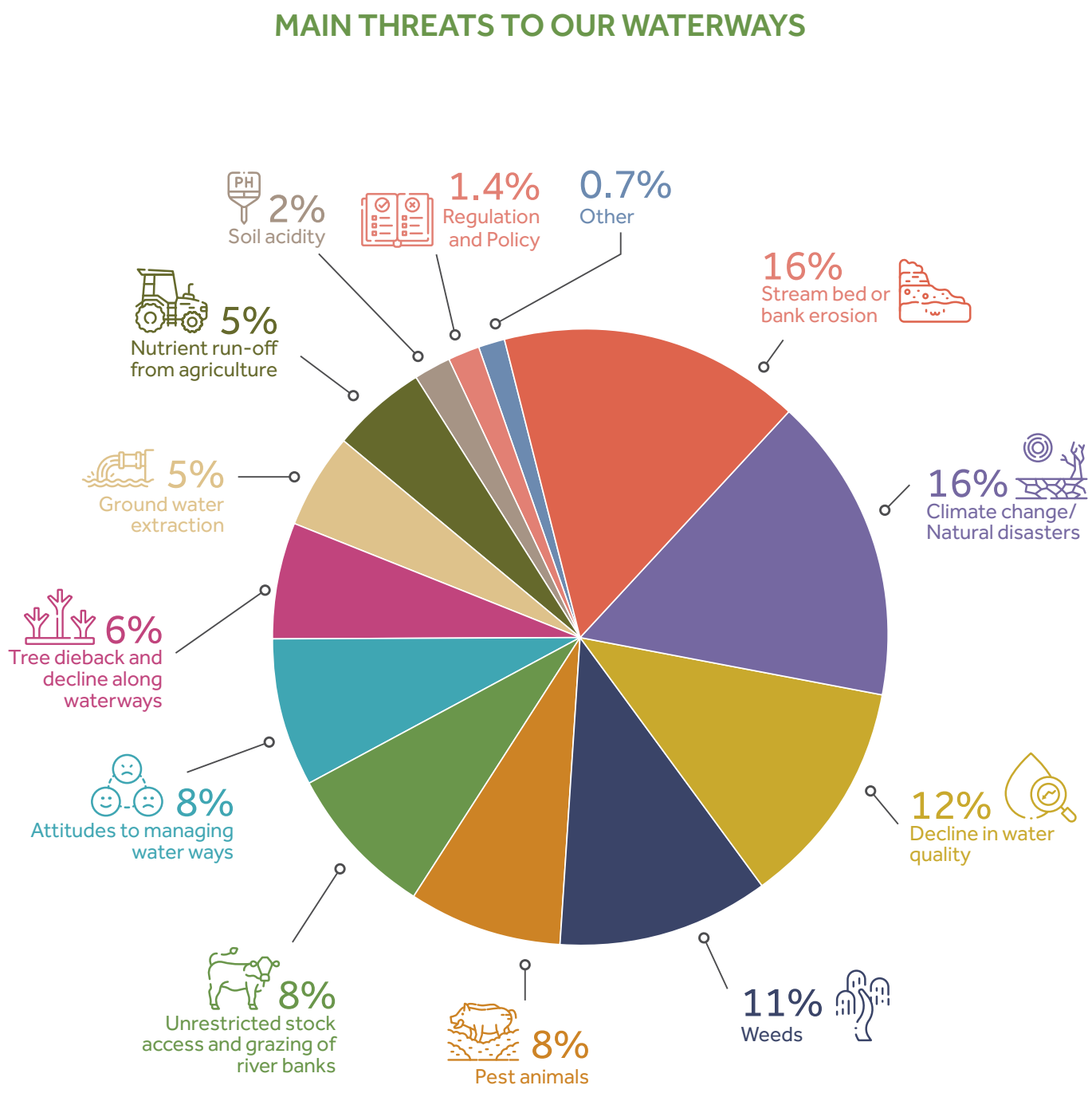


Figure 4: Main threats to waterways as ranked by the community.

6.1 STREAM AND GULLY EROSION

Stream bed and bank erosion was nominated as the highest threat to values in the catchment by the community. In 2002, the Upper Billabong Land and Water Management Plan (Holbrook Landcare Group, 2001) indicated that '*there are 466 km of streambank and gully erosion with the catchment. Sheet/rill erosion has impacted on 11% of the catchment*'. It also stated that *'it is predicted that gully erosion may increase to over 700 km by 2030 if certain landuse practices are maintained*.'

Murray LLS and its predecessors and partners have undertaken on-ground works to address erosion in the catchment in recent years. This information will be used as part of the prioritisation of works and implementation of actions in the Waterway Management Plan.

Challenges faced by farmers related to addressing erosion issues remain. These include access to technical advice on options to stabilise the site, the high cost of stabilisation solutions, access to suitably qualified contractors and assistance with completing the necessary permits. In the community survey some landholders also identified increased numbers of wombats and wombat activity as an issue causing more erosion along river banks.

Above: Gully erosion in the upper catchment on Little Billabong Creek. Credit: Kylie Durant.

6.2 CLIMATE CHANGE AND NATURAL DISASTERS

Survey respondents identified climate change, and associated disasters as important threats in the catchment. In the last decade alone, the Upper Billabong catchment has experienced significant events such as the Millenium Drought in the 2000s, bushfires in 2019-20, and floods in 2010-12 and 2022.

Climate change impacts such as bushfires and floods, and changes to seasonal temperatures and rainfall patterns are likely to have a major impact on the agricultural sector and the economy of the catchment.

It is important to anticipate changes due to climate change and to start to modify agricultural production techniques where possible, to reduce the impact on profits (NSW DPI 2011). Through the Waterway Management Plan it will be important to build resilience into floodplains though revegetating wide buffers along streams and managing stock access.

Above: Mountain Creek in flood, November 2022. Credit: Kylie Durant.

6.3 DECLINE IN WATER QUALITY

Decline in water quality (e.g. salinity, turbidity, total phosphorus) was voted the third highest threat in the catchment by survey respondents, despite there being a limited monitoring network to provide evidence for decline in the catchment.

6.4 WEEDS

Weeds are also an issue in the catchment, as identified in the community survey and data review. In 2001, the upper Billabong Land and Water Management Plan indicated that '*there are 18 noxious weeds currently recorded within the Shires. Noxious weeds currently of greatest concern include Blackberry, St John's Wort and Noogoora burr. To do nothing will lead to a proliferation of weeds*.'

Today, key species present in the catchment include Alligator Weed, Parrots Feather, Blackberries, Willows, Illyrian Thistle and Hawthorn. Alligator Weed is a Weed of National Significance (WONS) (van Oosterhout 2007), as are species of willow other than other than Weeping Willows (*Salix babylonica*) and two hybrid species of Pussy Willow (*S. x calodendron* and *S. x reichardtii*).

Above: Blackberry infestation along Wantagong Creek. Credit: Kylie Durant.

6.5 PEST ANIMALS

Pest animals were nominated as the fifth highest threat to values in the catchment. Terrestrial pest animals in Upper Billabong which impact on waterway health include deer, pigs and rabbits. Impacts include grazing of native riparian vegetation, bank erosion, weed invasion through animals transporting propagules and impacts to water quality through manure inputs and increased turbidity. Aquatic pest species include Gambusia, Carp and Redfin which compete with, and often predate, native fish species such as Southern Pygmy Perch.

Above: Gambusia are an invasive fish who compete with native fish for resources. Credit: Kylie Durant.

6.6 UNRESTRICTED STOCK ACCESS AND GRAZING OF RIVERBANKS

Unrestricted stock access and grazing of river banks was also an issue of concern for survey respondents. Impacts of stock access to waterways include localised bank erosion from livestock trampling, reduced water quality due to increased turbidity, increased nutrient loads from manure, and loss of riparian native vegetation, (especially aquatic reeds) from overgrazing.

Over the past 14 years, over 32 hectares of riparian land has been fenced from stock access to address bank erosion.

The survey results suggest that many people in the community understand the threat of stock access to waterways and believe that there is still more work to be done around the catchment.

Above: Cattle in creek. Credit: Rob Lacey.

6.7 ATTITUDES TO MANAGING WATERWAYS

Attitudes to managing waterways (e.g. old fashioned, out of date) was identified as an issue in 2001 in the Upper Billabong Land and Water Management Plan, and again in the community survey in 2022.

Comments from respondents indicated that '*old attitudes*' were a problem e.g focusing on productivity rather than environmental aspects of land management; and that '*new attitudes*' (e.g. natural sequence farming) were also an issue. One respondent noted that '*we need to be concerned about what is driving the regulatory and policy making bodies, and that they are using best practise or science not popular ideologies of the times*.'

7 Risk Assessment

A risk assessment was applied to survey results based on the values and threats listed. Below is the high and very high threats to highest ranked values. Key management actions in Section 8 are be based on mitigating these threats.

VALUES		THREATS							
		Weeds Stream bed or bank erosion	Climate change/ Natural disasters	Decline in water quality	Weeds	Pest animals	Tree dieback and decline along waterways	Unrestricted stock access and grazing riverbanks	Attitudes to managing waterways
ENVIRONMENTAL	Habitat for wildlife, including rare animals, plants and communities	Very high	Very high	Very high	High	Very high		Very high	Very high
	Natural wetlands		High	Very high		High		High	High
	Connected corridors for wildlife			High					
	Revegetated areas			High	High				
ECONOMIC	Stock and domestic water supply	High	High		Very high			High	High
CULTURAL	Cultural values and connection to Country (traditional owner values)	High	High		High			High	High

Very high High

Table 2: Risk assessment of high and very high threats to identified values.

8 Management actions

The following management strategies and actions have been developed for the very high and high risks identified in the risk assessment.

STREAM BED OR BANK EROSION

Action	Key values protected	Key stakeholders
Collate mapping of bed / bank erosion and sedimentation and identify priority intervention sites and rehabilitation options	• **Connected corridors** • **Revegetation** • **Stock and domestic water supply** • **Southern Pygmy Perch**	• Refreshing Rivers • Holbrook Landcare Network • Soil Conservation Authority • State-wide Southern Pygmy Perch Working Group
Make technical guidelines about work on waterways accessible to landholders including advice about permits for works on waterways	• **Stock and domestic water supply** • **Wetlands**	• Refreshing Rivers • Holbrook Landcare Network • Expert consultant • Landholders • Dept Planning & Environment • NSW Natural Resources Access Regulator (water licences) • Greater Hume Council
Establish local demonstration sites for erosion management • For example, revegetation (on banks and bars in the channel), managing existing revegetation, structural works for bank stabilisation.	• **Revegetation** • **Wetlands** • **Stock and domestic water supply**	• Refreshing Rivers • Holbrook Landcare Network • Expert consultant • Greater Hume Council
Broker investment in critical erosion management works	• **Stock and domestic water supply** • **Revegetation** • **Wetlands** • **Refuge Pools**	• Refreshing Rivers • Holbrook Landcare Network
Protect and restore wetlands and land • Work with agency stakeholders (such as Council and LLS) to prioritise and protect high conservation wetlands (including Seasonal Herbaceous Wetlands) and intact valley fill geomorphic features, on public and private land.	• **Wetlands** • **Stock and domestic water supply** • **Connected corridors**	• Refreshing Rivers • Holbrook Landcare Network • Soil Conservation Authority • Landholders
Continue to implement erosion management works in the catchment as resources become available	• **Stock and domestic water supply** • **Revegetation** • **Wetlands** • **Refuge pools**	• Refreshing Rivers • Holbrook Landcare Network • Landholders

CLIMATE CHANGE AND NATURAL DISASTERS

Action	Key values protected	Key stakeholders
Communicate likely impacts of climate change on local waterways	• **Revegetation** • **Refuge Pools** • **Wetlands** • **Stock and domestic water supply**	• NSW Department of Planning & Environment • Murray LLS • Holbrook Landcare Network • Greater Hume Council
Identify, protect and create refuge habitats in, and along, waterways	• **Southern Pygmy Perch** • **Mountain Galaxias** • **Refuge Pools** • **Wetlands** • **Freshwater Mussels**	• Refreshing Rivers
Develop a local area recovery Plan for the Southern Pygmy Perch	• **Southern Pygmy Perch**	• State-wide Southern Pygmy Perch Working Group • Refreshing Rivers • Holbrook Landcare Network
Monitor Southern Pygmy Perch and Mountain Galaxias populations in the catchment	• **Southern Pygmy Perch** • **Mountain Galaxias**	• Refreshing Rivers • Local community • Researchers
Establish or expand monitoring for rare and iconic species • Limited information is available for some species e.g. Rakali, Platypus, Sloane's Froglet and Climbing Galaxias	• **Refuge Pools** • **Wetlands**	• Refreshing Rivers • Local community • Researchers
Support existing riparian revegetation resilience program	• **Revegetation** • **Wetlands** • **Stock and domestic water supply**	• Refreshing Rivers • Holbrook Landcare Network • Landholders
Support existing project to develop climate ready revegetation guides for the catchment	• **Revegetation** • **Wetlands**	• Refreshing Rivers • Holbrook Landcare Network

Above: Fisheries NSW surveying for Southern Pygmy Perch in Spring Creek, 2019. Credit: Kylie Durant.

DECLINE IN WATER QUALITY

Action	Key values protected	Key stakeholders
Initiate a community campaign about water quality	• **Stock and domestic water supply** • **Southern Pygmy Perch** • **Freshwater Mussels**	• Refreshing Rivers • Water NSW • NSW Department of Planning & Environment • Local community
Create opportunities for citizen science water quality monitoring	• **Stock and domestic water supply**	• Refreshing Rivers • Local community • Landholders
Initiate work to further understand the effectiveness of local interventions on turbidity in the catchment	• **Stock and domestic water supply**	• Refreshing Rivers • Holbrook Landcare Network • Researchers
Support and initiate programs that address fertiliser efficiency, on-farm water efficiency and quality improvement	• **Stock and domestic water supply**	• Refreshing Rivers • Holbrook Landcare Network • Murray LLS
Continue to support groundcover improvement programs to reduce run-off into waterways	• **Stock and domestic water supply**	• Refreshing Rivers • Holbrook Landcare Network • Murray LLS
Expand existing water quality monitoring in the catchment	• **Stock and domestic water supply**	• Refreshing Rivers • Holbrook Landcare Network • Water NSW
Promote availability of testing for stock and domestic water	• **Stock and domestic water supply**	• Murray LLS • Refreshing Rivers • Holbrook Landcare Network • Landholders
Support enhancing farm dams projects	• **Stock and domestic water supply** • **Refuge Pools** • **Wetlands** • **Freshwater Mussels** • **Southern Pygmy Perch**	• Refreshing Rivers • Holbrook Landcare Network • Sustainable Farms (ANU) • Landholders

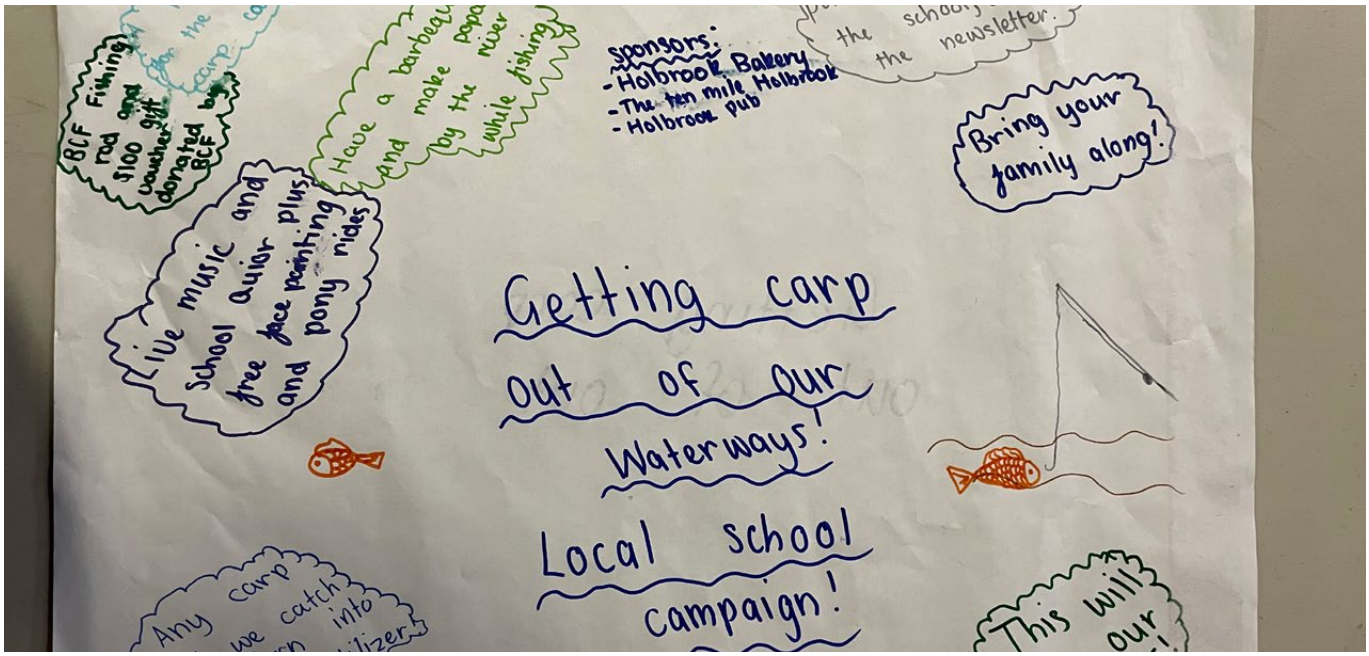
Above: High turbidity on Spring Creek in 2016. Credit: Kylie Durant

WEEDS

Action	Key values protected	Key stakeholders
Support Alligator Weed Eradication Program	• **Refuge Pools** • **Wetlands** • **Revegetation** • **Connected corridors**	• NSW Department of Planning & Environment • Murray LLS • Holbrook Landcare Network • Greater Hume Council
Facilitate control of Illyrian thistle in the Sawyers Creek catchment	• **Revegetation** • **Connected corridors**	• Greater Hume Council
Establish demonstration sites for woody weed control • For example, Willows, Green Cestrum, Blackberry, Hawthorn, Box Elder and Cottonwoods.	• **Revegetation** • **Wetlands** • **Refuge Pools** • **Connected corridors**	• Refreshing Rivers • Murray LLS • Holbrook Landcare Network • Greater Hume Council

PEST ANIMALS

Action	Key values protected	Key stakeholders
Support existing baiting programs for foxes, rabbits and pigs	• **Wetlands** • **Revegetation**	• Greater Hume Council • Murray LLS
Support existing deer and pig monitoring programs	• **Wetlands** • **Revegetation**	• Murray LLS • NPWS
Investigate options for reducing pest fish numbers e.g. Carp and Redfin	• **Southern Pygmy Perch** • **Mountain Galaxias** • **Refuge Pools**	



Above: Ideas from local students about reducing the impact of Carp on Upper Billabong waterways, November 2022.

UNRESTRICTED STOCK ACCESS AND GRAZING OF RIVER BANKS

Action	Key values protected	Key stakeholders
Increase the length of waterways with vegetated buffers • Refreshing Rivers targets - increase the extent of riparian revegetation through the development of 20 land management plans with landholders; revegetate 750 hectares of riparian land; regenerate (through weed control/ fencing/ pest control/ in-stream works) 750 hectares of riparian land; and conduct 17 activities to activities to address point source pollution.	• **Revegetation** • **Connected corridors** • **Stock and domestic water supply** • **Southern Pygmy Perch** • **Wetlands**	• Refreshing Rivers • Murray LLS • Holbrook Landcare Network • Landholders
Provide advice and broker investment for fencing and revegetating waterways; and managing existing revegetation	• **Revegetation** • **Connected corridors** • **Stock and domestic water supply** • **Southern Pygmy Perch** • **Wetlands**	• Refreshing Rivers • Murray LLS • Holbrook Landcare Network
Communicate the benefits of waterway fencing and revegetation	• **Revegetation** • **Connected corridors** • **Stock and domestic water supply** • **Southern Pygmy Perch** • **Wetlands**	• Refreshing Rivers • Murray LLS • Holbrook Landcare Network • Landholders
Identify barriers to fencing and revegetation	• **Revegetation** • **Wetlands**	• Refreshing Rivers • Murray LLS • Griffith University • Landholders
Improve data management for recording works undertaken	• **Revegetation** • **Connected corridors** • **Southern Pygmy Perch** • **Wetlands**	• Refreshing Rivers • Murray LLS • Holbrook Landcare
Promote best practice water resource planning	• **Revegetation** • **Stock and domestic water supply** • **Wetlands**	• Refreshing Rivers • Murray LLS • Holbrook Landcare Network • Water NSW

Above: On-farm discussions along Ten Mile Creek, 2019. Credit: Kylie Durant.

ATTITUDES TO MANAGING WATERWAYS

Action	Key values protected	Key stakeholders
Promote and recognise 'natural capital' stewardship	• **Connected corridors** • **Revegetation**	• Refreshing Rivers • Holbrook Landcare Network • Murray LLS • Landholders
Promote involvement in 'River Health' and 'River Friendly Farming' practices	• **Connected corridors** • **Revegetation** • **Wetlands**	• Refreshing Rivers • Holbrook Landcare Network • Murray LLS • Landholders
Develop property based riparian land management plans	• **Connected corridors** • **Stock and domestic water supply** • **Revegetation** • **Wetlands**	• Refreshing Rivers • Murray LLS • Landholders
Promote iconic threatened species and communities For example, Rakali, Galaxias, woodland birds, Box Gum Grassy Woodlands, mammals such as gliders, reptiles, amphibians such as Slone's Froglet, Southern Pygmy Perch and other fish.	• **Pygmy Perch** • **Freshwater Mussels** • **Connected corridors** • **Refuge Pools**	• Refreshing Rivers • Griffith University • Murray LLS • Holbrook Landcare Network • Local community
Create and promote opportunities for Traditional Custodians to connect and manage Country	• **Cultural values and Connection to Country**	• Traditional Custodians • Refreshing Rivers • Murray LLS • Local community
Wombat research	• **Connected corridors** • **Revegetation**	• Researchers • Landholders • Holbrook Landcare Network

Right: Community field days are important ways to raise awareness about iconic species in Upper Billabong, Ten Mile Creek in 2012. Credit: Kylie Durant.

9 Resourcing the actions in the Waterway Management Plan

Landcare has historically delivered incentive funding from various sources (eg State and Federal Governments, other NGOs, Industry research bodies and philanthropic sources) to assist landholders to do environmental works on a cost-share basis. There is now a trend towards less investment through grants, and a move to market-based instruments such as credit markets and accreditation schemes to drive more private investment in these activities. These markets have developed around carbon and biodiversity, with waterway-specific methodologies are being developed. There are also industry sustainability frameworks (e.g. beef and sheep) that have measures and targets for producers participating in these programs.

For landholders, a key part of these markets and accreditations systems is the identification of assets and benchmarking their condition using a recognised methodology. For investors it is having a mechanism to value and trade the 'credits' generated by improving those values that are measured with a recognized methodology.

These things are happening currently both in the government and private sectors. A focus of the Waterway Management Plan is to identify actions that fit with this model, and recognise that it may not be the traditional types of investment that drive change.

Above:Ten Mile Creek at Holbrook, Ian Geddes Bush Reserve. Credit: Rob Lacey.

10 Monitoring and evaluation

It is recommended that a mid-term review of the Waterway Management Plan be undertaken in 2026. This will enable an assessment of progress towards objectives; and the implementation of management strategies and actions. It will be an opportunity to modify actions or objectives, or add new actions or objectives, as issues are addressed, or new issues emerge. This adaptive management will help to ensure that the Waterway Management Plan remains a current, and relevant guide to actions that are required in the catchment to address threats to important values.

A final review of the Waterway Management Plan should also be conducted in 2031, to assess its effectiveness and inform future planning processes in the catchment, and more broadly in NSW.

Above:Part of the Ten Mile Creek catchment, headwaters in Woomargama National Park. Credit: Rob Lacey.

Refreshing Upper Billabong Waterway Management Plan was produced as part of the the Refreshing Rivers Program which is a collaboration between government, industry, research, and community organisations, led by Local Land Services.

This project has been assisted by the New South Wales Government through its Environmental Trust.

Find out more at www.refreshingrivers.org.au