GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

Goulburn Broken Regional Waterway Strategy

2013 – 2021

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Front cover: Kirwans Bridge Victoria - Wally Cubbin, Fishing Goulburn River along Majors Creek - Wally Cubbin, Goulburn River at Molesworth – Belinda Fisher, Water for Agriculture – C Sexton GB CMA,– Sunday Creek, Mt Disappointment - Krissi Flynn, Canoeing on the Goulburn River – GB CMA, Lake Benalla from Monash Bridge - Kirsten Hein, Mark Ainsworth, Murray Cod returned to the river - Wally Cubbin.

Our Strategy: The Goulburn Broken Regional Waterway Strategy underpins the Regional Catchment Strategy (RCS) on the integrated catchment planning framework for waterways and wetlands within our region and is the primary guide for priority setting, maintenance and improvement of waterways and wetlands in our region.

Our Vision

Resilient Waterways, Vibrant Communities.

The Goulburn Broken region's waterways and wetland systems are vibrant and resilient, so that communities can enjoy the range of values and benefits that they provide and contribute to their maintenance and improvement.

Foreword

Waterways and wetlands are the lifeblood of our region. They are also the barometer in which one can assess the current and past management of our waterways and surrounding catchment.

The Goulburn Broken Catchment Management Authority (GB CMA) as the lead agency for natural resource management in the Catchment is responsible for the development and oversight of a regional catchment strategy framework together with our community and partners.

The Regional Waterway Strategy is one of the sub-strategies, underpinning the Regional Catchment Strategy (RCS). The Regional Catchment Strategy presents the high level priorities, outputs and outcomes, whereas the Regional Waterway Strategy presents the detail and supporting framework to enable delivery on the strategic intent of the RCS.

The Goulburn Broken Regional Waterway Strategy, applies an asset-based approach and incorporates the resilience based thinking for maintaining the social, economic, cultural and environmental values. The Strategy recognises the vast range of social, environmental and economic values they provide to our regional community and visitors, alike.

The strategy reflects on the vast amount of work the community has achieved over many years and incorporates recent environmental and policy drivers and knowledge gained through research and monitoring. It identifies the key threats to community values and provides recommendations to influence the future management of waterways in the catchment. Actions to maintain and improve our waterways and wetlands are clearly established.

The Goulburn Broken CMA recognises its critical role in forming and developing regional partnerships with the community and all levels of government. Success in implementing this strategy is through partnerships, with our community and government agencies.

The Regional Waterway Strategy is a living document that will be continuously improved and updated over its life.

We wish to acknowledge the contribution of our community in the development of the strategy. Our community has contributed to the identification of values and threats, participation on the Community Reference Group and the submission of photographs depicting the way in which their local waterway is valued. Our partner agencies have also supported the development of the strategy through input on Reference Groups and direct contribution to Chapters of the Strategy.

We seek your support in its implementation, so that one of the region's most valued assets can be maintained and improved, for now and into the future.

Muray Chapman
Chair
Goulburn Broken Catchment Management Authority

About Our Strategy

Waterways and wetlands are one of the most striking features of our landscape – they provide us with enjoyment, provide cultural values, and contribute significantly to the economic and social health of our region and our community.

Our communities rely on the waterways and wetlands and the water contained within them, they sustain life and are valued for many reasons. Our waterways and wetlands provide us with an array of services, from the provision and carrying of water to our communities, primary producers and industry, through to providing us with cultural, tourism and recreational values.

There is no better time than for people in all catchments of Australia to simply stop and celebrate how vital waterways and wetlands are to the community, and to contribute towards their maintenance and improvement.

Local waterways and wetlands are not only valued by local communities, but the many visitors to the region and other users of our precious water resources well beyond our region

Waterways and wetlands while containing many species of plants and animals that are unique to Australia (like the Murray cod, Platypus or the humble Yabbie) they also provide billions of dollars to the economy, they support one third of all food produced in Australia, provide our everyday drinking water and support tourism and recreational opportunities. They are indeed a key asset to us all.

Our catchment has great places to camp, including the Goulburn River and tributary streams, and is also home of the Barmah Forest, the largest River Red Gum forest in Australia.

Fresh water is a scarce and precious resource in many areas across the globe. Within most of Australia we are fortunate to have good water supplies, but we have one of the driest climates in the world and our water reserves are not unlimited and many waterways are becoming increasingly polluted, work in the Murray Darling Basin (MDB) has commenced to better balance the water available for the health of the waterways.

The strategy reflects on the vast amount of work the community has achieved over many years and incorporates recent environmental and policy drivers and knowledge gained through research and monitoring. It identifies the key threats to community values and provides recommendations to influence the future management of waterways in the catchment

While our community is already taking action to maintain waterways and wetlands, there is still more that can be done. Taking positive action is the best way to help our waterways and wetlands.

Communities can assist and are protecting our waterways and wetlands, by: Finding out about our local waterways (and the values they contain/provide); Maintaining and managing buffer areas by fencing and re-establishing native vegetation; Maintaining and enhancing public reserves for waterway health; Getting involved with and encouraging participation in native fish and river health education programs; and working with local groups on waterway projects (Waterwatch, Landcare, Indigenous & recreational angling groups).

A review of the works undertaken over recent years provovides confidence that we are maintaining and improving many elements and reaches of the region's waterways and wetlands. Examples of this included reducing the level of nutrients entering our waterways, maintenance of threatened species (even after being subjected to fire and drought) and maintaining rivers in the catchment as prime recreational areas.

This Strategy encourages our community to enjoy our waterways and wetlands and contribute to their maintenance and improvement.

The Regional Waterway Strategy is one of the sub-strategies, underpinning the Regional Catchment Strategy (RCS). The Regional Catchment Strategy presents the high level priorities, outputs and outcomes, whereas the Regional Waterway Strategy presents the detail and supporting framework to enable delivery on the strategic intent of the RCS.

The intent of this Waterway Strategy is to:

- Identify priority waterways and wetlands based on their environmental, social and economic values, and set objectives for their management.
- Develop a program of works to achieve these objectives, and targets against which to measure the progress in reaching these objectives.

- Provide a consistent, defensible process for identifying priorities for Government investment in waterways and wetlands.
- Engage key stakeholders and the community in the process of developing the Regional Waterway Strategy to ensure that the priority assets chosen reflect areas of high community value.

The Strategy is a document that has been structured and compiled with input from our community and our many partners. The Strategy is a living document that will be regularly reviewed and updated over its life. This will require continuous engagement of community and partner agencies to ensure an adaptive management approach is used to enhance the resilience of our waterways and catchment as we face the challenges of the future together. A new challenge has been developing a workable resilience matrix for waterways based on sound science.

The Goulburn Broken Regional Waterway Strategy comprises four major sections:

PART A – Regional Overview and Strategic Context

PART B – The Approach, Vision, Goals and Guiding Principles

PART C – Regional Program – Implementation of Works and Activities

Part D – Implementing the Strategy

The Strategy identifies priority waterways and wetlands for investment into the next decade and identifies strategic challenges and opportunities.

The Goulburn Broken Regional Waterway Strategy also includes management planning for the Barmah Forest Ramsar Site in accordance with Action 12.3 of the Victorian Waterway Management Strategy.

In order to develop a list of priority waterways and wetlands, a number of filters have been applied to the large list of waterways identified within the Index of Stream Condition and Index of Wetland Condition. Filter one applied the definition of high value waterways as identified within the Victorian Waterway Management Strategy followed by filter two where we utilised the list of regional goals established by the Community Reference Committee.

Waterways are considered high value if they have one, or more, of the following characteristics:

- formally recognised significance
- presence of highly threatened or rare species and ecological communities
- high naturalness values (for example, aquatic invertebrate1 communities or riparian2 vegetation) or special waterway features (for example, drought refuges3 or important bird habitat)
- high social, cultural or economic values (for example, recreational fishing, Aboriginal cultural heritage and urban or rural water sources).

Regional Goals, established for waterways, were to maintain the resilience of the region's waterway and wetlands so that:

- waterways of high community value are maintained or improved.
- water quality in priority water supply catchments is maintained or improved.
- Populations of threatened aquatic dependent species will be maintained or improved- including Trout cod, Macquarie perch, Murray cod, Eel tailed catfish, *Barred galaxias*, Golden perch.
- Barmah Forest (Ramsar site) will retain its ecological character.
- The values associated with Heritage Rivers will be maintained or improved.
- Wetlands with formally recognised significance are maintained or improved.
- Waterways and wetlands in a near natural or ecologically healthy state are maintained.
- Urban waterways are managed to improve environmental condition, amenity and water security.

Additional filters included application of the risk based assessment, contained within AVIRA, and finally a review of project feasibility.

The target of investment over the next eight years will be on priority waterways and wetlands within the seven Social Ecological Systems. Within each Landscape priority waterways and wetlands are defined by reach and name (eg Basin -Waterway Reach (5-54), and Waterway Name (Broken River)

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In addition Challenges and Opportunities, facing waterways within the Goulburn Broken region have been identified for the Catchment Wide Social Ecological System.

The Regional Waterway Strategy is a living document that will be continuously improved, by adaptive management, leading to the updating of the Straegy over its life. A formal review process is recommended in 2017-2018 to review progress on the strategy, adapting to changes to the environment and our knowledge base.

The review and implementation will require continuous engagement of our community and partner agencies to ensure an adaptive management approach is used to enhance the resilience of the catchment and its waterways and wetlands.

Our waterways contain and provide our community with an array of social, economic, cultural and environmental values. This Strategy aims to maintain and improve these values through the implementation of key strategies and actions that will maintain the resilience of the region's network of waterways.

We look forward to implementing this strategy with the region's communities and partner agencies.

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Acknowledgment of Traditional Owners

The Goulburn Broken Catchment Management Authority and our community acknowledge the Traditional Owners of land, the Yorta Nations, Taungurung Clans and other custodians, in the Goulburn Broken Catchment and strongly respect the rich culture and intrinsic connection the Traditional Owners have to the land – past, present and into the future.

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Page 27	Photo credits: Tahbilk Fish Passage, crossing modification (Simon Casanelia), Broken River (Flood Recovery) G Brennan (GB CMA), Goulburn River Recreational Fishing Licence project (S Kosch GB CMA), Broken River (bank protection) G Brennan (GB CMA)
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Lake Nillahcootie

PART A

Regional Overview and Strategic Context

CHAPTER ONE:

Introduction

Waterways and wetlands are one of the most striking features of our landscape – they provide us with enjoyment and contribute significantly to the economic and social health of our region and our community. Our communities rely on the rivers and the water contained within them, they sustain life and are valued for many reasons.

The Goulburn Broken Catchment Management Authority together with the community and partner agencies has undertaken the development of this Regional Water Strategy. The Stratgy considers a review of the Regional River Health Strategy, which was first developed in 2004, applies learnings over the past decade, applies new data available on our waterways and wetlands and reflects on the work undertaken by regional agencies and the community over the past decade.. The Regional Waterway Strategy has been guided by the high level direction provided by the Regional Catchment Strategy (RCS) and the Victorian Waterway Management Strategy (VWMS). A significant amout of data collected for the RCS was able to be utilised in the preparation of this Strategy.

The current strategy which has served the region well has seen many areas of investment being delivered throughout the region, by the GB CMA, partner agencies and the community. This investment has provided a solid base for future investment and has enabled the maintenance and enhancement of many of the region's priority waterways.

The strategy is a regional document that underpin the RCS and has been developed in partnership with the community and partner agencies. The strategy will outline the management direction for rivers and wetlands in a region over an eight-year period.

As we progress forward, successful implementation of this strategy will provide the connection between waterway and land management. This strategy encourages local and regional ownership, partnerships and integration.

The strategy will use an assets based approach and like the RCS we will introduce a resilience approach to the regional priority setting process (recognising the environmental, social, cultural and economic values of waterways and wetlands).

There is no better time than for people in all catchments of Australia to appreciate how vital rivers are to the community, and to contribute towards their maintenance and improvement.

1.1 STRUCTURE OF THE DOCUMENT

The Goulburn Broken Regional Waterway Strategy comprises four major sections:

PART A – Regional Overview and Strategic Context **(Pages 1 to 73)**

- provides an overview of the regional waterway assets;
- describes the environmental, social and economic values (including recognition of Aboriginal values of waterways);
- outlining key threats;
- identifies key principles in developing the Strategy; and
- identifying future challenges and opportunities.

PART B – The Approach, Vision, Goals and Guiding Principles **(Pages 74 to 92)**

- presents the approach taken in the development of the Strategy;
- identifies high value waterways based on environmental, social and economic values.

- through a risk based prioritisation process, identify and spatially map priority waterways for investment over the next eight years

PART C – Regional Program – Implementation of Works and Activities **(Pages 93 to 144)**

- develops a regional work program for priority waterways (over the eight-year planning cycle)
- sets out the vision (50 year), methods used in developing the strategy and defines high level (20 year) goals for waterways in the region

Part D – Implementing the Strategy **(Pages 145 to 162)**

- identifies best practice, roles and responsibilities and factors affecting implementation of the Strategy.

1.2 THE REGIONAL WATERWAY STRATEGY

The second generation strategy will be known as the Regional Waterway Strategy (RWS) and has been developed by the Goulburn Broken Catchment Management Authority (CMA) in partnership with regional agencies and the community. This reflects the regional planning process for waterway management set out in the Victorian Waterway Management Strategy where regional Waterway Strategies provide a single planning document for waterway and wetland management in each region of Victoria. The RWS will be the primary mechanism for implementing state-wide waterway and wetland policy and will replace the current regional River Health Strategy (RHS) by 2014. The overarching aim of the Regional Waterway Strategy is to provide a single, regional planning document for whole-of-catchment management (i.e. rivers, estuaries and wetlands) and an action plan for achieving integrated waterway outcomes.

The Goulburn Broken Regional Waterway Strategy includes management planning for the Barmah Forest Ramsar Site in accordance with Action 12.3 of the Victorian Waterway Management Strategy.

The regional strategies are a statutory requirement under the *Water Act 1989* (Section 190) and also fulfil the statutory requirement for developing management plans for Heritage Rivers in accordance with the *Heritage Rivers Act 1992*. All Heritage Rivers will be considered as high value assets in the priority setting process and then management actions for these assets will be determined through the regional priority setting process.

There are also several other plans that do not have waterway health as their primary consideration, but have implications for waterway management and need to be considered in waterway health planning and implementation. These include other action plans under the RCSs such as the Regional Vegetation Plans, Biodiversity Action Plans and other relevant documents such as regional development plans.

The broad intent of the Regional Waterway Strategy is to:

- identify high value waterways (based on environmental, social, cultural and economic values)
- determine priority waterways for the eight-year planning period
- include a regional work program of management activities for priority waterways (including environmental water management)
- guide investment into multi-year projects and annual work programs

1.3 PROJECT LOGIC AND STRUCTURE OF THE DOCUMENT

This waterway strategy was prepared in accordance with the requirements of the *Victorian Waterway Management Strategy* (DEPI 2013) and ministerial guidelines (DEPI, 2013). Figure 1.1 (below) summarises the hierarchy of the document, going from the broadest level of the 'regional vision' to the finest level of activities targets. Figure 1.1 also provides direction to relevant Chapters of the Strategy.

Regional Scale	RCS Vision	**Chapter 5.2 – Healthy, resilient and increasingly productive landscapes supporting vibrant communities**
	Waterway Vision	Chapter 5.3: **Resilient Waterways and Wetlands, Vibrant Communities**
	Regional Goals	**Chapter 5.5:** Maintain resilience of the region's waterways, wetlands and communities (within a catchment context) so that: populations of threatened aquatic dependent species will be maintained or improved- including Trout cod, Macquarie perch, Murray cod, Eel tailed catfish, *Barred galaxias*, Golden perch; Barmah Forest will retain its Ecological Character; the values associated with Heritage Rivers will be maintained or improved; wetlands with formally recognised significance are maintained or improved; maintain and improve water quality in priority water supply catchments; maintain and improve waterways and wetlands of high community value
Waterway Scale	**Long-term condition target (8+ years)** (i.e. long-term target for waterway condition – relates to values identified in regional goals) **Management outcome targets (1 -8-years)** (i.e. short-term target addressing impact/risk – relates to impacts/risks to these values identified in risk assessments) **Output targets (Annual)** (i.e. target for activity to be conducted addressing impact/risk)	**Chapters 7.2 - 7.9**
	Project activities	Develop an annual Investment Plan and Annual Works Plan and Monitoring Program. Prepare and execute project contracts and service level agreements for the annual works plan and monitoring program. Hold works and activity meetings to plan and monitor the implementation of the project. Develop Annual Communications Plan Record and map annual works and monitoring program. Technical review and amendment of the 4 year project outcome and monitoring.
	Foundation activities	Communications Plan Documentation of Best Practice Compliance Activities Collate preferred/best practice pest plant control techniques. Collate relevant legislation, labels, permits and codes of practice to be complied with. **(Chapter 4)**
	Assumptions	Implementation of Best Practice will lead to maintaining or improving the resilience of the regions waterway (refer to: GHD (2012) Department of Sustainability and Environment - River and Estuary Conceptual Models to Support Development of Regional Waterway Strategies. GHD)

Figure 1.1 Logic framework, linking vision, regional goals and targets

1.4 IMPLEMENTING THE STRATEGY

The implementation of this waterway strategy will be influenced by available funding and resources, level of community support and the impacts of extreme events within the region. Investment proposals to support actions within the strategy will be developed as investment opportunities arise. The strategy will be implemented within an "adaptive framework", with continued reviews incorporated into annual planning cycle.

1.5 GUIDING PRINCIPLES

The following principles define the management approach to be taken in the planning and implementation of this Strategy:

Partnership approach – waterway management will continue to be a partnership between government, industry and the community

Community involvement – communities will have the opportunity to be involved in waterway management and this participation can help foster increased stewardship

Integrated catchment management – integrated management of waterways will occur within a broader framework of integrated catchment management. Management will recognise the importance of waterways as a connection between catchments, groundwater, coasts and the receiving marine environment, and the strong influence of land use and catchment condition on waterway condition

Appropriate tools – the full complement of instruments and approaches will be considered to improve waterway condition including; direct Government investment in on ground works, grant and incentive programs, management agreements and covenants, market-based instruments, information and extension programs and regulation

Value for money – Government will direct investment to regional priority management activities that provide the most efficient and effective long-term improvements in waterway condition and the greatest community gain

Regional Waterway Strategies and management plans – facilitate regional decision-making with community input and use a risk-based approach to identify high value waterways and priority management activities. They will:

- consider environmental, social, cultural and economic values of waterways
- be holistic and integrate on ground works with environmental water management
- ensure efficient and effective management of the environmental water
- include maintenance as a vital activity to secure both past and future investment in on ground works
- be flexible in response to seasonal climatic variation and plan for the potential impacts of climate change.

Evidence-based decision-making - best available knowledge will underpin decision making, policy and waterway management programs. This Stratgy is underpinned by the resilience approach.

Adaptive management - policy and programs are part of a broader framework of adaptive management (supported by effective monitoring, reporting, evaluation and research) to ensure continuous improvement.

Nagambie Lakes (W Cubbin), Great Egret on Lake Benalla (Kirsten Hein), Lake Benalla Waterway Trail (GB CMA), Tahbilk backwaters (GB CMA),Young Macquarie perch (ARI), Building protective fencing on Hollands Creek (GBCMA), Hughes Creek rock pool (GB CMA), Fishing the Goulburn River (W Cubbin)

CHAPTER TWO:

Regional Overview: The Goulburn Broken Catchment

The Goulburn Broken Catchment extends from the Great Dividing Range near the outskirts of Melbourne to the River Murray on the border with New South Wales. (Figure 2.1).

The Catchment contains a diversity of landscapes, communities and natural and manmade features. Our landscapes boast snow-covered Alps, forests, granitic outcrops, gentle sloping plains, box woodlands and red gum floodplains and a mosaic of natural assets, river pathways, forested regions and agricultural development.

Waterways, floodplains, wetlands and groundwater aquifers (GB CMA, 2013) are an integral part of the Catchment, providing many environmental, social and economic values. Waterways and water underpin the livelihoods of our community, supporting agriculture and urban centres, contain significant flora and fauna, support high value recreational, tourism and aesthetic values, and are central to the culture of our Traditional Owners.

2.1 WATERWAYS AND WETLANDS

Rivers, floodplains and wetlands are an integral part of the catchment providing many environmental, social, cultural and economic services. They underpin livelihoods (providing water for agriculture, commercial and domestic uses), contain significant flora and fauna habitat, have high recreational and aesthetic values, and are central to the culture of local Indigenous communities.

There are two major river basins within the Catchment, the Goulburn and Broken (refer to Figure 2.1). These form part of the Murray-Darling Basin and cover approximately 2.4 million hectares or 10.5% of Victoria and 2% of the Murray-Darling Basin.

The total length of waterways within these basins is over 44,000 km. The vast majority are small ephemeral headwater streams found on the steep slopes of the Great Dividing Range in the south of the Catchment. Larger more perennial rivers and creeks total approximately 15,000 km in length.

2.2 GOULBURN RIVER BASIN

The Goulburn River Basin is Victoria's largest covering 1.6 million hectares or 7.1% of Victoria. The Goulburn River itself is 570 km long, flowing from the Great Dividing Range upstream of Woods Point to the Murray River east of Echuca. It has a mean annual water discharge of 3,040 GL representing 13.7% of the total state discharge. Native vegetation has been retained over much of the mountainous areas in the south, where slopes are steepest. However clearing for agriculture has been extensive in the valleys and plains.

Stream flow along the Goulburn River has been modified by two major features, Eildon Reservoir and the Goulburn Weir. Lake Eildon is located in the river's upper catchment, immediately below the confluence to the Delatite River. It has a capacity of 3,334 GL. On average, 91% of water released from Lake Eildon is diverted for irrigation purposes and supplies about 60% of water used in the Goulburn Murray Irrigation District (G-MW website). With such a large storage capacity, operation of the lake fully regulates downstream flows in all but wet years (GB CMA 2008). The Goulburn Weir is approximately 235 km downstream of Lake Eildon, and north of Nagambie. It holds 25 GL and is usually held close to full capacity to facilitate the diversion of water into irrigation channels and to supply Waranga Basin. Waranga Basin has a capacity of 432 GL and is used to store winter and spring flows from tributaries downstream of Lake Eildon.

The Goulburn River, its tributaries and associated floodplain and wetland habitats support a variety of threatened species of high conservation value including the iconic Murray Cod, the endemic *Barred galaxias*, one of only two self-sustaining populations of Trout cod in Australia and the critically endangered Alpine tree frog. The waterways and their associated floodplain and wetland habitats also contain many important cultural heritage sites, provide water for agriculture and urban centres within and downstream of the basin, and support a variety of recreational activities such as fishing and boating.

The Goulburn River downstream of the Goulburn Weir is listed in 'A Directory of Important Wetlands in Australia' and downstream of Lake Eildon it is classified as a Heritage River under the *Heritage Rivers Act 1992* (Vic) together with Big

River and the Howqua River upstream of Lake Eildon. Upper reaches of the Goulburn, Taggerty and Big Rivers have been classified as ecologically healthy.

There are several major rural towns and cities in the Goulburn basin including Shepparton, Mooroopna, Seymour and Kyabram, and a further eight communities with populations greater than 1,500.

2.3 BROKEN RIVER BASIN

The Broken River basin is 772,386 hectares or 3.4% of Victoria's total area. The Broken River is a tributary of the Goulburn River and joins the Goulburn River at Shepparton. The basin also includes the catchment of the Broken Creek that diverges from the Broken River west of Winton Wetlands and flows north-west to the Murray River.

Most of the Broken River catchment has been cleared of native vegetation for agriculture comprising grazing in the south and mixed cereal and dryland grazing in the central region. A large part of the northern section is within the Murray Valley irrigation district where intensive horticultural, dairy and livestock production occurs.

Broken River stream flow is extremely variable between seasons and between years. The three months from July to September generally account for over half the annual stream flow. The catchment has a mean annual flow of 325,000 ML. However annual flow has varied from a minimum of 5,000 ML in the drought year of 1943, to a maximum of more than 1,000,000 ML in the flood years of 1917 and 1956.

Two major storages have been constructed within the catchment, Lake Nillahcootie and Lake Mokoan. Lake Nillahcootie is located in the Broken River's upper catchment and has a capacity of 40,000 ML. The Lake provides water for stock, domestic and irrigation. Lake Mokoan was constructed in 1971 and had a capacity of 365,000 ML. It was an off river water storage designed to provide water to the Murray and Goulburn irrigation areas. The Victorian Government in 2004 as part of the Our Water Our Future White Paper decided to decommission Lake Mokoan and restore its natural wetland habitat. The Winton Wetlands Committee of Management is overseeing the restoration project.

Hollands Creek Native Fish Project

Nestled within the Tatong Valley the Hollands Creek Demonstration Reach Project targets the protection of river health for Hollands Creek and the threatened Macquarie perch.

The project is addressing a range of threats to river health including undertaking riparian improvements (through fencing, stock control and revegetation), weed control and increasing the diversity of in stream habitat.

A number of field days have been held with the community and the project is supported by a Community Reference Group who meets regularly to track progress on the project.

The Broken River, its tributaries and associated floodplain and wetland habitats are a stronghold for native flora and fauna in the region including many threatened species that are of high conservation value including Silver perch and the nationally threatened Macquarie perch.

The Broken Creek, Muckatah Depression and the Broken River downstream of Benalla are listed in 'A Directory of Important Wetlands in Australia' and a reach of Ryans Creek in the upper Broken River catchment has been classified as ecologically healthy.

The city of Benalla is the largest urban community in the basin. There are also a number of major towns including Cobram, Nathalia, Yarrawonga and Numurkah.

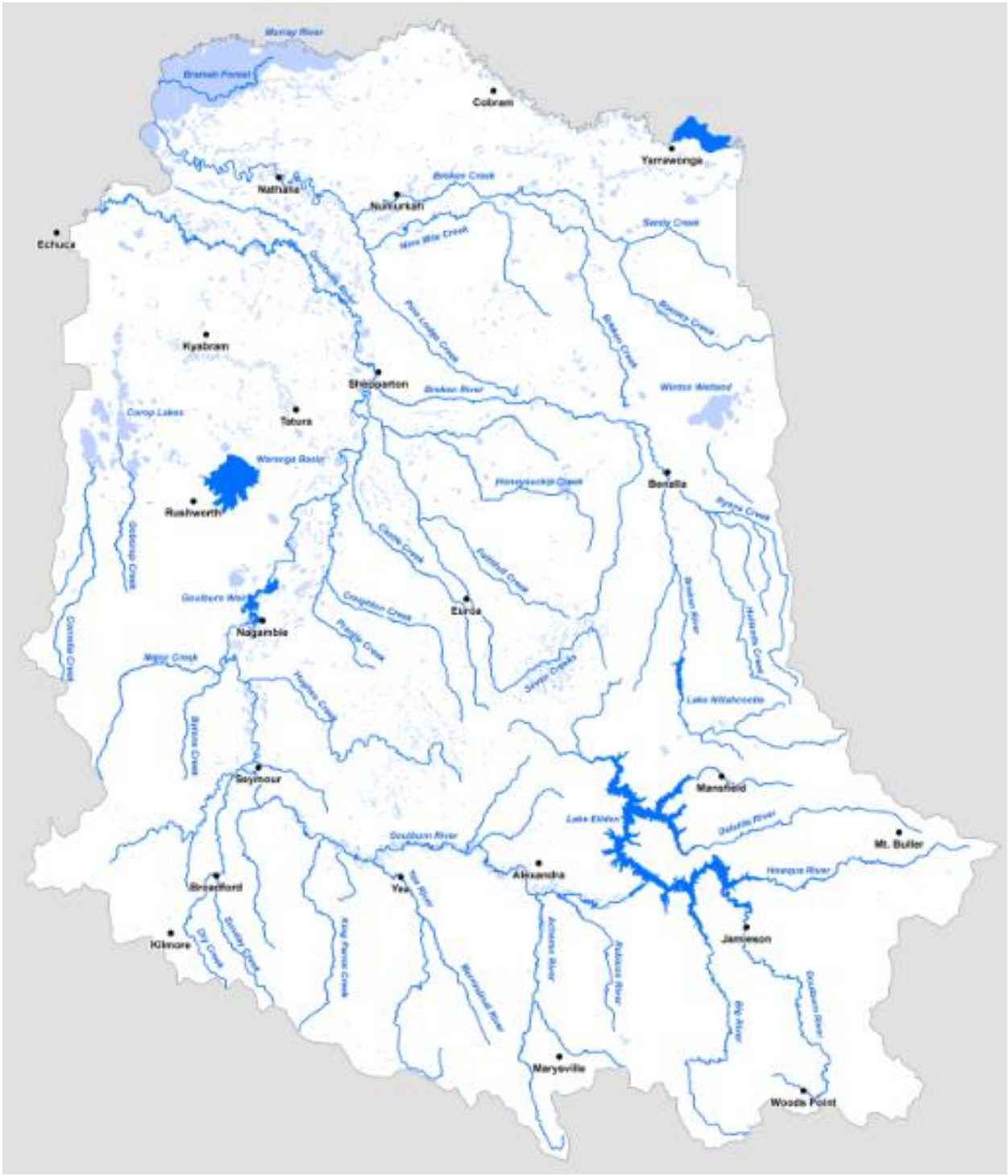


Figure 2.1 – The Goulburn Broken catchment

2.3.1 VALUES AND THREATS

Values

The local community and visitors to the region identify with a range of values that they see as important to maintain and protect:

- Recreational fishing;
- Native Flora and Fauna;
- Water Supply for townships, stock and domestic;
- Water Supply for Agriculture and Industry;
- Tourism and Recreation;
- Cultural and Heritage; and
- Aesthetic and Lifestyle.

Threats

Threatening activities and processes include, but not limited to:

- catchment clearing
- climate variability
- groundwater extraction
- pest plant and animal invasion
- snag removal
- stock access to riparian zones
- waterway regulation and flow diversion
- river channel hydrology (rates of rise and fall, unseasonal flow)
- urban and agricultural development.

These activities and processes are linked to:

- physical degradation of riverbanks and channels
- reduced water quality and temperature
- loss of in stream and riparian habitat and complexity
- modified flow and flood regimes
- a decline in the diversity and abundance of biodiversity
- reduced primary production and nutrient cycling
- changes to river and floodplain morphology
- disruption of lifecycles and breeding cues.

2.4 WATERWAY CONDITION

Waterway condition in Victoria (DEPI, 2013d) is assessed using the Index of Stream Condition (ISC).The ISC is an integrated measure of river condition and assesses changes in hydrology, water quality, streamside vegetation, bed and bank condition, in stream habitat and aquatic macroinvertebrate diversity.

In 2004 ISC assessment of selected river reaches in the Goulburn and Broken Basins indicated that most are in moderate (54%) and poor (23%) condition, and a small proportion are in very poor condition (6%). This is due to modified flow regimes, degraded riparian vegetation, poor bank condition and low water quality from elevated nutrients. Approximately 11% of reaches were assessed to be in good condition and 5% in excellent condition. Ryans Creek and the Big, Howqua and Rubicon Rivers all have reaches in excellent condition. These waterways are all unregulated and native vegetation has been retained over much of their catchments.

Within the Murray-Darling Basin (MDB) native fish populations are estimated to be at approximately 10% of pre-European settlement levels (MDBC, 2004a). Alien fish species account for the majority of fish biomass in many of our waterways.

The 2010 ISC assessment noted the following: Water quality was monitored at 23 reaches across the Goulburn Broken region. The majority of reaches were in moderate condition (44%), followed by 21% in excellent condition and 18% in good, 13% in poor and 4% in very poor condition.

Water quality was assessed in seven of the 36 reaches in the Broken River basin. Of these, five were in moderate condition, one in poor condition and one, reach 22 on the Broken Creek, and was in very poor condition. All reaches tested had elevated levels of phosphorus and turbidity. The generally poor water quality reflects the highly modified natural environment.

Flow stress scores varied widely across the Goulburn Broken region with some streams under extreme flow stress and others with natural, or near natural, flow regimes.

In the Broken River catchment, flow stress scores ranged from one, at reaches 1 and 2 on the lower Broken River to nine at reaches 16 and 17 on Ryans Creek. In the Goulburn River catchment, flow regimes of streams below Lake Eildon were under significantly more stress than those in the upper reaches of the catchment. Notably, the lower reaches of the Goulburn River (1-14) had highly modified flow regimes, reflected in flow stress scores of zero or one. In contrast, reach 34 on Deep Creek at Barmah had a near natural flow regime. Upstream of Lake Eildon, reaches 15 and 16 on the Goulburn River, reaches 67 and 68 on the Big River and reaches 69 and 70 on the Howqua River also had natural or near natural flow regimes.

Results for the condition of vegetation in the streamside zone across the region ranged from reaches in poor condition to those in reference condition. Reflecting land use, reaches in reference condition were located in the densely vegetated south of the region and those in poorer condition were predominantly located in areas where land had been cleared. Overall, the majority of reaches (56% in both the Broken and Goulburn catchments) were in good or excellent condition.

Results for physical form in the Goulburn Broken region ranged predominantly from moderate to good. Of the 117 reaches assessed, 35 reaches (30%) were in moderate condition and 68 reaches (58%) were in good condition. Of the remainder, 4 reaches (3%) were in poor physical condition and 10 reaches (9%) were in excellent condition.

Almost every reach in the Goulburn Broken region was assessed for aquatic life (105 out of 117 reaches tested). The majority of the reaches were found to be in good or excellent condition (39% and 16% respectively). Of the remainder, 16% were in poor condition and 29% were in moderate condition. No reaches in the Goulburn Broken region were assessed as very poor.

2.5 WETLANDS OF THE GOULBURN BROKEN REGION

Wetlands are areas of permanent, periodic or intermittent inundation that hold still or very slow moving water. They support ecosystems adapted to flooding. Wetlands may be formed by natural processes or be human-made and play a key role in the maintenance of the hydrological, physical and ecological health of river systems. Wetlands perform numerous vital functions including water purification, nutrient processing and retention, maintenance of watertables, flood protection, erosion control and groundwater recharge. They provide habitat, refuge, and breeding and nursery areas for many common and threatened species which are partially or wholly dependent on these habitats. Wetlands are a vital element of national and global ecosystems and economies. At the most fundamental level, wetlands are a key part of the water cycle, playing critical roles in maintaining the general health of Australia's rivers, estuaries and coastal waters.

In the Goulburn Broken region over 2000 wetlands have been mapped and classified and cover approximately 86,000 ha. These wetlands include large permanent lakes, floodplain billabongs, small spring soaks, alpine bogs and shallow freshwater

Tahbilk Lagoon, a biological hot spot

Tahbilk Lagoon is a biological hot spot. The lagoon supports a variety of aquatic and terrestrial biota including a large self-sustaining Freshwater catfish (Tandanus tandanus) population and Victoria's largest known population of the threatened Watershield (Brasenia scherberi). The 280 ha lagoon is connected to the Goulburn River 10 km south west of Nagambie Township. The GB CMA in conjunction with ARI, G-MW, Tahbilk Winery and adjacent landholders have been working cooperatively over the last five years improve the aquatic habitat of the lagoon by researching the movement and habitat preferences of Freshwater catfish, controlling aquatic and terrestrial weeds, fencing to control stock access, revegetating riparian zones, increasing in-stream habitat through re-snagging, and improving native fish passage by upgrading three road crossings. In addition, interpretive signs outlining the values supported by the lagoon and the work undertaken to protect and improve them have been installed around the lagoon to inform the many visitors to this popular destination.

depressions. The vast majority of wetlands are ephemeral, occur on private land, are less than 10 ha in size and occur on the region's floodplains. Of these a number have been formally recognised for their conservation significance. These include the internationally significant Barmah Forest Ramsar Site, ten wetlands of national significance listed in A Directory of Important Wetlands in Australia (DIWA) and an assessment as part of the former National Land and Water Resources Audit in 2001 identified 111 wetlands of bioregional significance in the region. In addition, a large number of wetlands support state and nationally threatened biota and communities, and birds listed on international agreements and conventions.

Since European settlement the extent of some wetland types have declined by 20 to 60 per cent in region. These have predominantly been smaller and less permanent wetlands as they are more susceptible to threats such as drainage and water regulation. Conversely, the construction of artificial impoundments has increased the total extent of permanent wetlands in the region since European settlement.

2.5.1 WETLANDS OF SIGNIFICANCE

Significant wetlands are defined as those listed in the Directory of Important Wetlands in Australia (Environment Australia, 2001). A number of reaches in the Goulburn Broken Catchment are associated with significant wetlands:

The lower Broken Creek, associated with the Barmah-Millewa Forest wetlands (Broken Basin Reach 21);

- Broken Creek reaches, associated with various wetlands (Broken Creek, Muckatah Depression) listed in the Directory (Broken Basin Reaches 22-26); and
- The Goulburn River downstream of Goulburn Weir, associated with various wetlands (Kanyapella Basin, Lower Goulburn Floodplain) listed in the Directory (Goulburn Basin Reaches 1-8);
- The lower Broken River, associated with the Lower Broken River wetlands listed in the Directory (Broken Basin Reaches 1-2);
- Gobarup and Wanalta Creeks associated with the Wallenjoe wetlands listed in the Directory (Goulburn Basin Reach 33).

Significant wetlands in the Goulburn Broken Catchment listed in the Directory of Important Wetlands in Australia (Environment Australia, 2001) is shown in Table 2.1

Table 2.1 - Significant wetlands in the Goulburn Broken Catchment listed in the Directory of Important Wetlands in Australia (Environment Australia, 2001

Wetland Name	Location and description	Area (ha) (Ramsar Listed)
Barmah-Millewa Forest	Murray River floodplain between Ulupna Island and Barmah	29,500 (Ramsar)
Broken Creek	Between 8 km NNW of Benalla to Barmah Forest. Includes Moodie Swamp.	2,500
Muckatah Depression	11 km SE of Yarrawonga to 2 km east Numurkah. Includes Dowdle Swamp gazetted as State Wildlife Reserve.	2,909
Kanyapella Basin	13 km ESE of Echuca. Kanyapella Wildlife Management Co-operative Area.	2,581
Lower Goulburn River Floodplain	150 km d/s Goulburn Weir to Murray confluence. Heritage River, 2 State Wildlife Reserves (Gemmill Swamp & Reedy Swamp) & Loch Garry Wildlife Management Co-operative Area.	13,000
Lower Broken River	Between 8 km NNW of Benalla & Shepparton	1,268
Wallenjoe Wetlands	10 km N of Colbinabbin	*303*
Central Highlands Peatlands	Upper Goulburn Catchment. Includes Oaks, Poley, Snobs, Tom Burns and Storm Creeks.	*33*
Big River	Upper Goulburn Catchment. Heritage River	*1,465*
Howqua River	Upper Goulburn Catchment. Heritage River	*1,520*

Threats

Wetlands are resilient and adaptive but are threatened by many activities and processes including:

- catchment clearing
- climate variability
- drainage or infilling of wetland habitat
- groundwater extraction
- pest plant and animal invasion
- stock access
- waterway regulation and flow diversion
- urban and agricultural development

These activities and processes are linked to:

- a decline in the diversity and abundance of wetland dependent flora and fauna
- disruption of lifecycles and breeding cues
- loss of wetland habitat and complexity
- modified wetting and drying cycles
- physical degradation of soils
- reduced primary production and nutrient cycling
- reduced water quality and temperature

Remote cameras in Barmah Forest

Selected waterbird nesting sites are now being remotely monitored by Goulburn Broken CMA wetland managers using remote cameras. Installed in wetlands next to nests, the cameras are programmed to take an image every 30 minutes and "beam" it back to the CMA office. Water managers can then keep track of nesting and the birds' water requirements while minimising site disturbance and reducing the time-consuming task of field visits. Water managers can promptly respond by adjusting inflow rates to ensure that the nesting sites retain adequate water depth until the young birds successfully fledge.

2.6 WETLAND CONDITION

Wetland condition is assessed using the Index of Wetland Condition (IWC). The IWC is an integrated measure of wetland condition and assesses changes in hydrology, water quality and salinity, surrounding vegetation, original size and form, soil disturbance, and the diversity, structure and composition of wetland vegetation.

Since 2009 IWC assessments have been carried out on 116 wetlands across the region. Results indicate that most are in good (38%) and moderate (40%) condition, and a small proportion are in excellent (6%), poor (15%) and very poor condition (<2%). The percentage of wetlands in excellent or good condition after such a long dry period indicates both the effectiveness of management and the degree of wetland resilience. However, the fact that approximately 57% of wetlands are in moderate to very poor condition indicates that many wetlands in the region are still subject to threatening processes. The results also indicated that wetlands on public land are generally in better condition than those on private land, although there are still examples of wetlands in good condition on private land.

Information on condition is used to inform policy, assess risks to the values of rivers, estuaries and wetlands, determine management priorities, set targets and monitor the longer term trends in condition. Condition data helps DEPI and Catchment Management Authorities (CMAs) identify the processes that threaten rivers, estuaries and wetlands and understand how these systems respond to management actions to address those threats.

2.7 RECOGNITION OF ABORIGINAL VALUES OF WATERWAYS

The Goulburn Broken Catchment is a rich and diverse community. The Catchment has an estimated population of 215,000 people (Montecillo 2012), which includes approximately 6,000 Indigenous Australians, many which identify as Traditional Owners of this area (GB CMA 2013).

The Traditional Owners of the Goulburn Broken Catchment have an intrinsic connection to the landscapes, wildlife and water within the landscape (GB CMA 2004).

Traditional Owners in the north of the Catchment (see Figure 2.1) are represented by Yorta Yorta Nation, whose traditional lands include the northern plains of the Goulburn and Murray Rivers. Yorta Yorta Nation is defined by eight clan groups: Moira; Kailtheban; Wollithiga; Nguaria-iiliam-wurrung; Ulupna; Kwat Kwat; Bangerang and Yalaba Yalaba. (see yynac.com.au)

Tradiditional Owners in the south of the Catchment (see Figure 1) forms part of the traditional lands of Taungurung Clans, which includes the mountains and rivers to the Great Divide. Taungurung Clans is defined by nine clans: Buthera Balug; Look William; Moomoom Gundidj; Nattarak Balug; Nira Balug; Warring-Illum Balug; Yarran-Illam; Yeeren-Illam-Balug and Yowung- Illam Balug. (see Taungurung.net)

The Yorta Yorta Nation Aboriginal Corporation (YYNAC) and Taungurung Clans Aboriginal Corporation (TCAC) are both Registered Aboriginal Parties (RAPS), under the *Aboriginal Heritage Act 2006*[1]

Traditional Owners' knowledge of land and water resources and cultural heritage in the landscape is rich and unique.

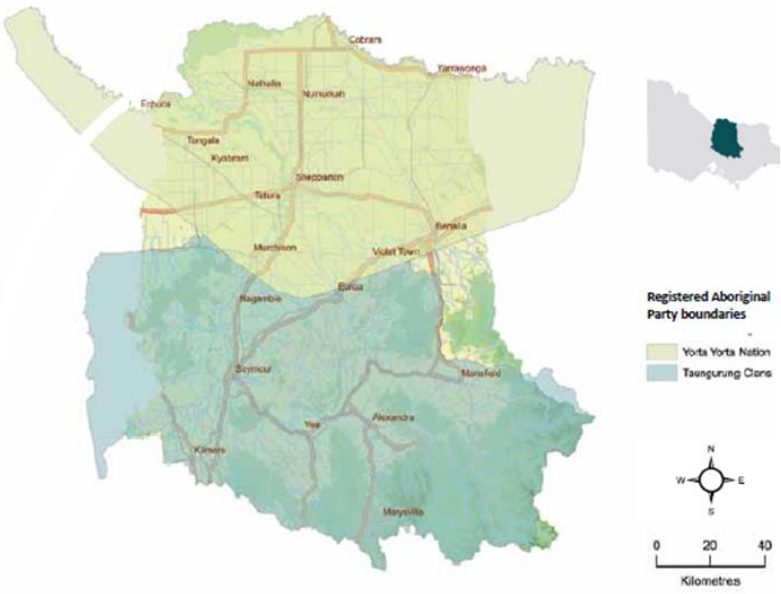


Figure 2.1 – Registered Aboriginal Party boundaries within the Goulburn Broken region

Affinity with the land, waterways and wildlife

[1] The *Victorian Aboriginal Heritage Act 2006* (the Act) recognises Aboriginal people as the primary guardians, keepers and knowledge holders of Aboriginal cultural heritage. At a local level, Registered Aboriginal Parties (RAPs) are the voice of Aboriginal people in the management and protection of Aboriginal cultural heritage.

RAPs have responsibilities relating to the management of Aboriginal cultural heritage under the Act. These include evaluating Cultural Heritage Management Plans, providing advice on applications for Cultural Heritage Permits, decisions about Cultural Heritage Agreements and advice or application for interim or ongoing Protection Declarations

The traditional owners (GB CMA, 2005) remain connected to and feel a strong affinity with country, including the land, waterways and local ecology. Traditional Owners remain strongly committed to exploring practical ways of connecting both heritage and cultural knowledge practices into land and waterways management, so as to pass on to future generations. It needs to be recognised that there is no separation between natural values, social and economic aspirations of these communities.

Recent Involvement in Protection of Values

The traditional owners have felt a sense of frustration regarding gaining access to waterways within their traditional country .

Over the past five years a number of partnership projects have been developed between Traditional Owners and the wider community. Recent projects involving Traditional Owners, on country include: Protection of the Ecological Character of Barmah, co-management of river corridors and wetlands (Barmah Forest), Management of Weeds of National Significance within the upper Goulburn River catchment, and Protection of Sandhills in the lower Goulburn River floodplain, Dookie Biolinks projects and protection and development of Cultural Heritage Management Plans. These project have included works on country, employment and training and capture and dissemination of Traditional Ecological Knowledge.

The path forward

The Yorta Yorta people believe that we need to be at the forefront of decision making an d management when it comes to waterways.. The structuring of water usage and management to have benefit to indigenous peoples is based on a paradigm of belief generated by the idea that a sustainable culture and thus livelihood's are nurtured by a sustainable environment. The key driving factor behind this sustainable environment in the flood plain ecological terrain that runs through much of Yorta Yorta country is indeed generated by appropriate irrigation of the land at the required times with the ideal amounts of watering for relevant species and country. This must be done so as to help the earth and all its associated systems flourish so as to provide a health landscape which is in turn a platform for a healthy cultural and social landscape.

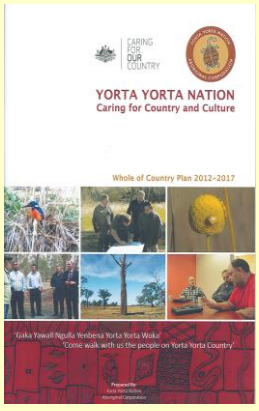
Yorta Yorta Nation - Caring for Country and Culture / NRM Plan

The Yorta Yorta Natural Resource Management Plan (Whole of Country Plan) respects and promotes the aspirations and role of Yorta Yorta Nations in managing "Country"

The Plan, funded under the Federal "Caring For Our Country" initiative, affirms Yorta Yorta knowledge, values and priorities of their country, gained by the Yorta Yorta people over thousands of years, This knowledge is fundamental in the development of fully comprehensive and effective NRM strategies/plans and practices in natural resource management of the Natural Environment and the required understanding of the Traditional Owner symbiotic relationships with the land and water, spiritually/physically socially and economically.

The Whole of Country Plan captures views about how and what needs to be the focus of stewardship activity in 2012 and beyond. The planning horizon for the plan is 2012 - 2017

The Plan includes an Action Plan, which includes target areas and strategies for on-ground application.



The very essence of water itself, being flow is of high spiritual importance to indigenous peoples and represents **"**The physical health of country is also directly connected to the physical, emotional and spiritual health of the Yorta Yorta People. Land and Water as natural resources are not only necessary for survival, but are sacred and require protection and sustainable management under Yorta Yorta lore- a system of natural resource management that kept country and people healthy for thousands of years" (Yorta Yorta Whole of Country Plan 2012-2017)

It is then of critical value that Waterways and wetlands are viewed within Yorta Yorta ideology, particularly being a floodplain based people over a large portion of our country. All wetlands sit in a position of high importance. Some more so for containing a high diversity of available resources. But even those of less abundant commodities are valued in a

cultural sense on the same tier of significance. For example the act alone of being by the river is a direct, ancestrally inherited use of the water with intrinsic spiritual, cultural and social values imbued in the place, time and experience.

Considering these factors, the monitoring of treatment of waters and flows is indeed significant to indigenous Yorta Yorta ideology also in relation to the impact that flows have on those communities downstream, knowing that other communities upstream have respected waters so as to provide for quality water.

Fauna

The impact that watering regime has on culturally significant fauna species is also one of imperative importance. Through lack of water, or lack of water to specific wetland areas the effects can be debilitating for species such as the Broad Shelled turtle, the totem of the Yorta Yorta people. Evidence has shown that through lack of correct watering regimes can lead to an overpopulation of significant turtle habitat. This has contributed to many deaths as a result.

Through recent research, the Yorta Yorta in consultation with Arthur Rylah institute have already conducted a detailed monitoring program of broad shelled turtles within the landscape of the Barmah National Park. “The Yorta Yorta people and ARI shared their knowledge to find out more about the local distribution and abundance of this species. The Elders shared Indigenous Ecological Knowledge and the creation story of the turtle and IRA shared survey identification techniques and scientific knowledge of the turtles. This will help to determine where and when to direct cultural flows to ensure the on-going survival of this species in the region”. (Yorta Yorta Whole of Of Country Plan 2012-2017)

It is thus a high priority for Yorta Yorta people to be strongly involved in all future research into and management of water on Yorta Yorta country. The focus in particular of how it relates to threatened, rare and totemic species is paramount. This has been identified as one of the key areas of capacity building amongst Yorta Yorta people moving in to the future with the underlying feelings that it is absolutely critical for indigenous people to be heavily involved in this space that is believed to be a sacred and spiritual one. “ Land use plans and park management plans should incorporate Yorta Yorta knowledge about endangered and threatened species, and traditional approaches to protection alongside specialised contemporary methods” (Yorta Yorta Whole of Country Plan 2012-2017)

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Partnerships: Working on Country with Taungurung

The Taungurung Weeds of National Significance (WONS) Caring for Our Country project is a joint program between Taungurung Clans Aboriginal Corporation and Goulburn Broken CMA for the control of WONS in high priority wetlands. The project also captures and exchanges Traditional Ecological Knowledge across Taungurung country. Within the Strathbogie Ranges the innovative project is building cross-cultural relationships with Taungurung and local landholders through local Landcare facilitators.

The project whilst protecting rare wetlands is also facilitating the sharing of cultural information held by landholders for generations. The project has given Taungurung people an instrument to create a cultural map of their Traditional lands utilised by their ancestors.

The following Table details Strategic Actions for implementation over the next eight years:

Action	Timeframe	Responsibility
Support the development of a "Country" Plan for the Taungurung Clans Aboriginal Corporation	2018	TCAC
Support the implementation of the intent and priority initiatives contained within the YYNAC (Working on Country Plan)	2013 - 2021	YYNAC, state and regional agencies

Photo credits: Scar tree in the Landscape (YY NAC from NRM Plan): Working on Country (YYNAC), Participants on Yorta Yorta Youth Journey (G Sutherland)

2.9 COMMUNITIES VALUE THEIR WATERWAYS

Waterways of the Goulburn Broken region are the lifeblood of the local community and are highly valued by visitors to the region. The water generated from the catchment is also highly valued by the local community and the many towns and communities downstream.

Waterways support our regional economy (agriculture, tourism and recreation), provide cultural and heritage values and provide places for our community and visitors to enjoy.

Waterways can play a vital role in the physical and mental well-being of people and communities. Our social and recreational activities often revolve around waterways and many Victorians, especially Traditional Owners and Aboriginal people, have deep social, cultural and historical connections to them. The comments below show how important waterways are to people's lives.

Waterways within the region are also popular destinations for visitors to the region. From the alpine areas with natural values through to the lowland streams that are utilised for both passive and active recreation. Our waterways and major wetlands are some of the most visited areas of land over holiday season.

The Goulburn River harnesses and supplies water for irrigation, urban and environmental purposes by two major features, Lake Eildon and the Goulburn Weir. This water underpins the economic and social wealth of the region.

A survey of recreational fisherman found that the Goulburn Broken Catchment includes some of the most popular recreational fisheries in Victoria. In 2012, a survey of recreational fishers highlighted that this region features both the most popular recreational fishing lake (Lake Eildon) and river (Goulburn River). Other important fisheries in the GB CMA region include Lake Nagambie, Eildon Pondage, Waranga Basin, Broken River and Lake Mokoan.

A survey of 7,140 Victorians (Pisarski and Cary, 2010) found that waterways are vitally important to community members, with 99 per cent of respondents having high aspirations for waterways.

Specifically to the Goulburn Broken region,

The benchmark survey captured 1116 respondents who used waterways in many different ways and for many different purposes:

- The most frequently mentioned waterway use was – beside water use - for simply enjoying aspects of the environment such as the scenery, native animals, plants and birds and for recreational activities such as walking, hiking, cycling and picnics and barbeques.
- Recreational fishing was quite popular with on water users.

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CHAPTER THREE:

Strategic Context

This Chapter:
Sets the strategic context for the Regional Waterway Strategy by outlining its relationship to other regional, state and federal policies; and
Discusses achievements/knowledge gained during implementation of the previous regional RHSs; and discusses Key Management Issues.

3.1 STATE FRAMEWORK

The Victorian Waterway Management Strategy (VWMS) provides the framework for government, in partnership with the community, to manage rivers, estuaries and wetlands so they can support environmental, social, cultural and economic values now and into the future. The VWMS updates the Victorian River Health Strategy (VRHS) which was a significant milestone for river management in Victoria and extends the scope to cover waterways generally, including wetlands and estuaries. It outlined clear principles for making regional decisions on river maintenance and restoration, identifying regional priorities for management activities and state-wide direction on important management issues affecting river health.

Victoria's water allocation framework provides the basis for the management of Victoria's water resources. Under the *Water Act 1989*, the Victorian Government retains the overall right to the use, flow and control of all surface water and groundwater on behalf of all Victorians. All water taken for consumptive purposes is done so under entitlements set out in the Water Act 1989. Victoria's water allocation framework takes a whole-of-system water management approach and considers all water resources (surface water and groundwater) for both consumptive and environmental purposes at all phases of the water cycle. Like surface water, groundwater is allocated for commercial and irrigation purposes under strict licensing arrangements under the *Water Act 1989*.

The *Water Act 1989* also defines the Environmental Water Reserve (EWR) as the amount of water set aside to meet environmental needs. The Victorian Environmental Water Holder was established in 2011, under the Water Act 1989, as an independent statutory body responsible for making decisions on the most efficient and effective use of Victoria's environmental entitlements.

The *Water Act 1989* (s.190) requires 'an Authority' that has a waterway management district to prepare a 'regional waterway strategy' for the purposes of performing its functions under s.189 (1) of the Act. The *Water Act 1989* lists the nine Catchment Management Authorities and Melbourne Water Corporation as authorities with a waterway management district. The new regional Waterway Strategies will replace the existing regional River Health Strategies that was prepared by the Goulburn Broken community in 2004. The regional Waterway Strategies are a key component of the integrated waterway management framework (see Figure 3.1) outlined in the draft Victorian Waterway Management Strategy (VWMS).

The key state-wide policy framework for water quality protection in Victoria is the State Environment Protection Policy (Waters of Victoria). It provides a statutory framework for State and local government agencies, businesses and communities to work together to maintain and rehabilitate Victoria's surface water environments. The SEPP(WoV) identifies beneficial uses of water and sets the environmental quality objectives and policy directions required to address higher risk impacts and activities.

The *Flora and Fauna Guarantee Act 1988* (FFG Act) is the key piece of Victorian legislation for the conservation of threatened species and communities and for the management of potentially threatening processes. The FFG lists threatened species and ecological communities; and threatening processes. The FFG provides for the preparation of a Flora and Fauna Guarantee Strategy. The "strategy" was launched as Victoria's Biodiversity Strategy.

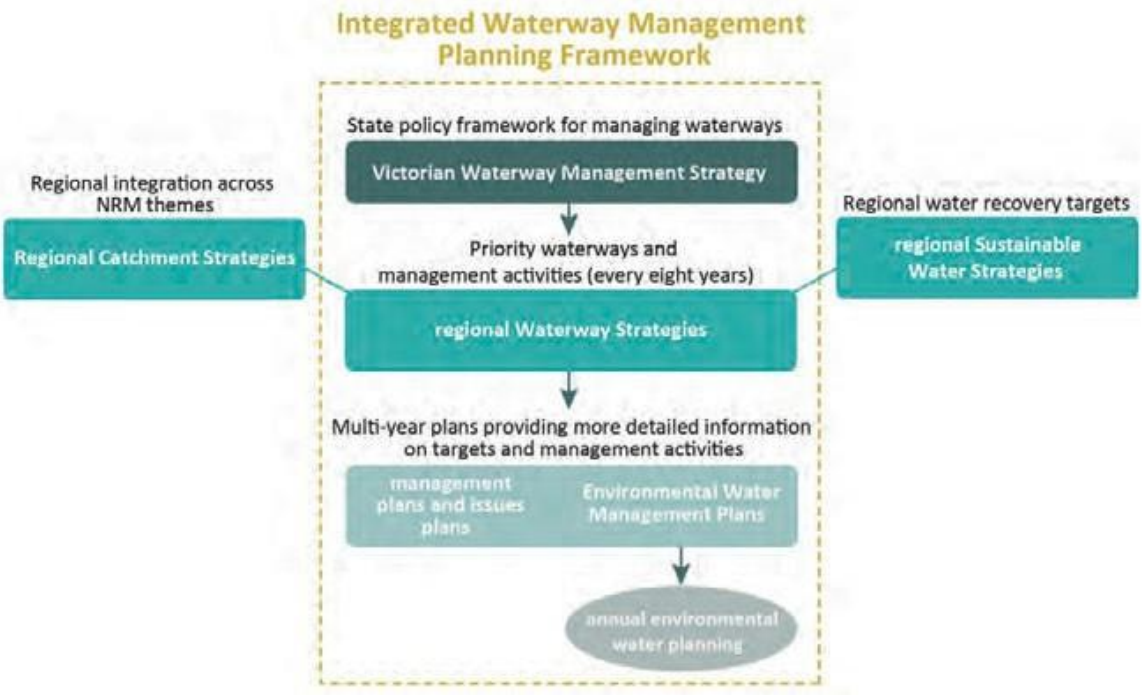

Figure 3.1 – Integrated waterway management framework

3.2 REGIONAL FRAMEWORK

The *Catchment and Land Protection Act 1994* establishes Regional Catchment Strategies (RCSs) as the primary framework for integrated management of land, water and biodiversity in each of the ten catchment regions of Victoria. The Goulburn Broken Catchment Management Authority is responsible for preparing the Goulburn Broken RCS and co-ordinating and monitoring its implementation. The Goulburn Broken RCS is the overarching strategy, under which are a range of sub-strategies and action plans for the Goulburn Broken region. The long-term objectives and priorities for action in the Goulburn Broken RCS that relate to waterways will be implemented through this Strategy.

Regional planning processes for waterway management were established in 2002 under the VRHS and implemented through the ten regional River Health Strategies (RRHSs). Community input and participation in these regional planning processes was a critical element to ensure that regional planning reflected the community values of waterways in each region. The RRHSs identified high value rivers and priority management actions to be undertaken over a six-year period. These RRHSs were the cornerstone of the regional planning framework for waterways (supported in some areas by regional wetland strategies), but have now passed their intended lifespan. The development of this Strategy is a statutory requirement under the *Water Act 1989* and will replace the current Regional River Health Strategy 2004 (RRHS).

Water resource planning in Victoria is addressed through development of regional Sustainable Water Strategies (SWSs) that set out long-term regional plans to secure water for regional growth, while safeguarding the future of its rivers and other natural water sources. They investigate the range of potential changes to water availability under several climate change scenarios. The regional SWSs examine future consumptive demand and environmental needs and set out proposed options to balance and secure water for all users. The SWSs are where the Victorian Government, in partnership with regional communities, decides whether additional water is required for the environment.

3.3 NATIONAL FRAMEWORK

At the federal level, water reform has been guided by the National Water Initiative (NWI) since 2004. Under this agreement, governments across Australia have committed to actions to achieve a more cohesive national approach to the way Australia manages, measures, plans for, prices, and trades water. The NWI recognises the need to build on the water reforms of the 1994 Council of Australian Government (COAG) agreement to ensure increased productivity and efficiency of Australia's water use. It includes clear steps to return river and groundwater systems to environmentally sustainable levels of extraction and achieve integrated management of environmental water. The program focuses on environmental sites: as per MDBA website: http://www.mdba.gov.au/about-basin/environmental-sites

There has also been significant legislative reform in water resource management at the federal level. The *Water Act 2007* (Cth) established the Murray-Darling Basin Authority (MDBA) and requires the MDBA to prepare the Basin Plan – a strategic plan for the integrated and sustainable management of water resources in the Murray-Darling Basin. The Act also established the Commonwealth Environmental Water Holder to manage the Commonwealth's environmental water. The *Water Amendment Act 2008* (Cth) transferred the functions of the Murray-Darling Basin Commission to the new Murray-Darling Basin Authority (MDBA). The MDBA is now the single body responsible for overseeing water resource planning in the Murray-Darling Basin and a strategic plan for the integrated and sustainable management of water resources (the Basin Plan) was signed into law in November 2012. The Basin Plan sets legal limits on the amount of surface water and groundwater that can be taken from Victoria's share of the Murray-Darling Basin from 1 July 2019 onwards.

The Living Murray Initiative is one of Australia's most significant river restoration programs. It aims to achieve a healthy working Murray River system for the benefit of all Australians. This includes returning water to the environment. The Living Murray has recovered almost 500 gigalitres of water to help improve the health of six icon sites. The Living Murray program was established in 2002 in response to evidence showing the declining health of the Murray River system. It is a partnership of the NSW, Victorian, South Australian, ACT and Australian governments, coordinated by the MDBA.

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) is the Australian Governments central piece of environmental legislation. It provides a legal framework to maintain and manage nationally and internationally important flora, fauna, ecological communities, Ramsar sites and heritage places defined in the Act as matters of national environmental significance. The *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* establishes a framework for managing Ramsar sites. The Australian Ramsar Management Principles set out in Schedule 6 of the *Environment Protection and Biodiversity Conservation Regulations 2000 (Cwlth)* provide direction on the management of Ramsar sites. These principles are applied to the management planning for the Barmah Forest Ramsar Site within the Goulburn Broken RWS.

The *Native Title Act 1993* (Cth) provides a framework for the maintenance and recognition of native title. The Act gives Indigenous Australians who hold native title rights and interests—or who have made a native title claim—the right to be consulted and, in some cases, to participate in decisions about activities proposed to be undertaken on the land.

3.4 INTERNATIONAL FRAMEWORK

The Australian Government has ratified several international human rights instruments that recognise and maintain Indigenous peoples' special connection to land and waters and provide for the right to practice, revitalise, teach and develop culture, customs and spiritual practices and to utilise natural resources (for example, the United Nations Declaration of Rights of Indigenous Peoples).

The Convention on Wetlands of International Importance (the Ramsar Convention) provides the framework for national action and international co-operation for the conservation and wise use of wetlands and their resources. The Convention encourages member countries to nominate sites containing representative, rare or unique wetlands, or that are important for conserving biological diversity, to the List of Wetlands of International Importance (Ramsar sites). Within the Goulburn Broken Region, the Barmah Forest is listed as a Ramsar site. As a contracting party to the Ramsar Convention, Australia is required to meet a number of obligations including the maintenance of the ecological character of its Ramsar sites through conservation and wise use. The Ramsar Convention also encourages planning to promote the conservation and sustainable use of all wetlands*. The Goulburn Broken RWS also addresses this requirement at the regional level

Ramsar sites are a matter of national environmental significance under the *Environment Protection and Biodiversity Act 1999* (Cth). JAMBA, CAMBA and ROKAMBA listed species and species recorded in GBCMA wetlands is shown in Table 3.1.

Table 3.1 - JAMBA, CAMBA and ROKAMBA listed species and species recorded in GBCMA wetlands

Common Name	Scientific Name	JAMBA	CAMBA	ROKAMBA	CMA Wetland
Garganey	Anas querquedula	✓	✓	✓	✓
Fork-tailed Swift	Apus pacificus	✓	✓	✓	✓
Eastern Great Egret	*Ardea modesta*	✓	✓		✓
Sharp-tailed Sandpiper	Calidris acuminata	✓	✓	✓	✓
Curlew Sandpiper	Calidris ferruginea	✓	✓	✓	✓
Red-necked Stint	Calidris ruficollis	✓	✓	✓	✓
Latham's Snipe	Gallinago hardwickii	✓	✓	✓	✓
White-bellied Sea-Eagle	Haliaeetus leucogaster		✓		✓
White-throated Needletail	Hirundapus caudacutus		✓		✓
Caspian Tern	Hydropogne tschegrava (Hydroprogne caspia)		✓		✓
Bar-tailed Godwit	Limosa lapponica	✓	✓	✓	✓
Rainbow Bee-eater	Merops ornatus	✓			✓
Grey Plover	Pluvialis squatarola	✓	✓	✓	✓
Painted Snipe	Rostratula benghalensis		✓		✓
Wood Sandpiper	Tringa glareola	✓	✓	✓	✓
Marsh Sandpiper	Tringa stagnatilis	✓	✓	✓	✓

A number of waterways in Victoria have been recognised as being of international, national or state significance. Management of these waterways will be consistent with any obligations outlined in relevant state, national and international legislation, policy and agreements. For example, as a contracting party to the Ramsar Convention, Australia is required to meet a number of obligations including the maintenance of the ecological character of its Ramsar sites through conservation and wise use.

3.5 FORMALLY RECOGNISED SIGNIFICANCE

Within the Goulburn Broken Region, the Barmah Forest is listed under the Ramsar Convention on Wetlands. The Convention is an intergovernmental treaty that provides the framework for international cooperation for the conservation and wise use of wetlands, one of the most threatened habitats in the world. The Barmah Forest Ramsar Site was listed in 1982. Management planning for the Ramsar site within the Goulburn Broken RWS is aimed at maintaining the ecological character of the Ramsar site at the time it was listed.

As a Contracting Party to the Ramsar Convention, Australia is required to maintain the ecological character of its Ramsar sites at the time they were listed through conservation and wise use. The ecological character is defined by the Ramsar Convention as “the combination of the ecosystem components, processes and benefits/services that characterise the wetlands at a given point in time”. A change in ecological character is the “human induced adverse alteration of any ecosystem component, process and or ecosystem benefit/service.”

The Goulburn Broken Regional Waterway Strategy includes management planning for the Barmah Forest Ramsar Site in accordance with Action 12.3 of the Victorian Waterway Management Strategy.

An ecological character description (ECD) has been completed for the Barmah Forest Ramsar Site (SEWPaC 2013). This defines limits of acceptable change (LACs) for ecosystem services/benefits (values) and physical, chemical and biological ecosystem components and processes that are considered critical to the ecological character of the Ramsar site. (refer to Appendix H.) The plan also recommends monitoring needs for the Ramsar site.

3.6 ROLES AND RESPONSIBILITIES OF THE CMA, COMMUNITY AND PARTNER ORGANISATIONS

The Goulburn Broken CMA, along with nine other CMAs, was established in 1997 by the Victorian Government, under the *Catchment and Land Protection Act 1994*, with the aim of creating a whole of catchment approach to natural resource management in the state.

The primary goal of the Victorian CMAs is to ensure the maintenance and restoration of land and water resources, the sustainable development of natural resources-based industries and the conservation of our natural and cultural heritage. Under Part 10 of the *Water Act 1989*, CMAs are designated with specific responsibility for the management of waterways, drainage and floodplains.

The range of functions that CMAs undertake include:

- developing a Regional Waterway Strategy and associated action plans
- developing and implementing work programs
- authorising works on waterways, acting as a referral body for planning applications, licences to take and use water and construct dams, for water use and other waterway health issues
- identifying regional priorities for environmental watering and facilitating water delivery
- providing input into water allocation processes
- developing and co-ordinating regional floodplain management plans
- managing regional drainage, as appropriate
- responding to natural disasters and incidents affecting waterways such as bushfires, floods and algal blooms
- undertaking community participation and awareness programs.

To enable the delivery of waterway management actions (including those roles that impact on waterways from a catchment perspective) key partnerships have developed within the Goulburn Broken region. These partnerships, with several State agencies that have a major role in waterway management together with regional partnerships has led to the identification and clarity around key roles and responsibilities (see Appendix A) from DEPI 2013.

3.7 REVIEW OF THE RIVER HEALTH STRATEGY (2004)

The Regional River Health Strategy (2005) and the midterm review "Addendum" provided direction for the river health program over the past decade. Driving investment, priorities and delivery of on-ground works for the authority, partner agencies and the community. The Goulburn Broken Regional River Health Strategy (2004) recommended a mid-term review of this strategy where a detailed evaluation of the Strategy's implementation. The review assessed achievements made, whether progress is adequate, and consider whether there is new science and knowledge that needs to be taken into account and incorporated.

3.7.1 THE ADDENDUM – MID TERM REVIEW

Following completion of the Regional River Health Strategies in 2004 a number developments and new directions in Victorian water resource management policy followed (Our Water Our Future - 2004, Our Environment Our Future - 2006, Regional Sustainable Water Strategies – 2009 and the *Water (Resource Management) Act 2005*).

Further challenging river health and Victoria's water resource management was the impact of drought, with the state experiencing over a decade dry conditions and large areas subjected to catastrophic wild fires. More recently 2010 – 2012 significant areas have been subjected to unseasonal summer flooding.

The former RRHSs were aimed at long term management during long-term average climate conditions, and do not adequately cover contingencies required to manage through extreme drought and/or dry years. To address this issue CMAs and Melbourne Water (MW) commenced development of Environmental Drought Response Plans (EDRPs) in each summer from 2006/07 through to 2009/2010. These plans identified the high value ecological assets seriously at risk

during low flow periods and put in place work and emergency watering programs to protect these assets, increased monitoring programs and contingency actions where necessary.

A review of the Strategy (The Addendum) followed the above events and aligned with the recommendation for a mid-term review.

3.7.2 LEARNINGS FROM THE REVIEW

Table 3.2 summarises the major learnings from the review of the Goulburn Broken Regional River Health Strategy 2004 and implications of recent policy, environmental factors and knowledge that will influence the future management of natural resources, river health and water in the catchment. Table 3.2 also presents the progress towards meeting these recommendations at the time of preparing the Goulburn Broken Regional Waterway Strategy (2013).

Table 3.2 - influence of reviews on the River Health Program.

Influence and Method of Incorporation	Action Taken / Knowledge gained	Status
Policy Development of operating strategies for priority systems that address management of the systems under current and future climate change scenarios have been included as priority actions under EWR priorities.	Climate change project initiated (development of ERA process). Annual Watering Plans (process developed and employed) for the Broken River, Broken Creek, Goulburn River and wetlands.	Achieved
Prepare drought management plans and dry inflow management plans will continue to be prepared. This information to be incorporated into regional refugia planning processes.	Dry inflow management plans evolved into Annual Watering Plans. Refugia project information considered in their development. Refugia identified under low flow.	Achieved
Plan and implement infrastructure upgrades to supply environmental water to priority wetlands. (MU's L1, L4 and L2).	Progressing through the EWR team (see below). Environmental watering employed.	Achieved
Identify high priority actions and projects within Flagship areas, biolinks and high priority waterways (see Figure 3.1, Figure 4.2 and Chapter 4)	Working with biodiversity team to identify. Look at sites benefiting terrestrial and aquatic biodiversity.	Achieved
Environment Catastrophic wild fires have destroyed a significant area of the upper Goulburn River catchment. Major focus on the rehabilitation and post fire recovery effort in priority management units (U2, U3, U4 and U6) and priority river reaches in transition Year and in the Addendum.	Fire recovery project initiated in upper Goulburn catchment.	Achieved
CMA maintains a strategic and ongoing role in projects to enhance knowledge base with respect of climate variability and impact of dry inflows and incorporate findings as appropriate.	Charles Sturt University - Identifying low risk climate change adaptation: A case study of the Goulburn Broken Catchment Management Authority (Lukasiewicz et al., 2012) University of Canberra – Predicting water quality and ecological responses to a changing climate: informing adaptation initiatives (Dyer et al., 2012; Harrison et al., 2012)	On-going
Foster regional refugia planning to identify future scenarios and opportunities for effective investment. Incorporated in to regional program (Strategic and EWR)	Zonation project (Monash University) undertaken for the Goulburn Broken region.	completed

Table 3.2 (Cont.) - influence of reviews on the River Health Program.

Influence and Method of Incorporation	Action Taken	Status
Develop local management rules to manage stream flows in priority river reaches / catchment (Yea River and King Parrot Creek).	G-MW has started this process	On-going
Support water strategies, support water savings and educate community of the links between landuse change and water quality and river health through engagement programs.	Progress being made on a number of fronts (and by a range of partners)	On-going
Supports efforts to identify and monitor for potential threats (acid sulphate soils, reduced flows, extraction)	Waterwatch undertook some site assessments – no sites identified.	Implemented and ongoing
Knowledge Identification and delivery of integrated programs benefiting both river health and biodiversity.	Still some progress to be made. Good progress with wetland Tender project.	Ongoing
Plan for a review of the Regional River Health Strategies prior to 2013 based on the direction of VSHREW. Strategy will be expanded to cover the proposed Northern Rivers Natural Resource and Catchment Authority region.	This current review	in progress
Assessment of Achievements Overall, a substantial program of works has been implemented across the catchment. However, an assessment of progress of all works related actions to date against targets indicates that a substantial number of works targets are significantly behind schedule, with original targets being more aspirational with the expectation of more resources. A substantial program of complementary initiatives has been implemented. These initiatives underpin works investment and assessment of long term effectiveness of works undertaken. Many priority programs are continuing. Priorities, reduced targets to be aligned with current funding levels. Clear targets established within priority reaches, management units (including the nature of target action). Alignment of programs to State and Federal priorities (biolinks, flagship and resilience).		

3.7.3 ACHIEVEMENTS 2004 – 2013

The RRHS was completed in 2005 and reviewed in 2010. To guide development of this Regional Waterway Strategy a brief review of the RRHS (to 2013) was undertaken. The review found.

A substantial program of complementary initiatives has been implemented which underpin works investment and assessment of long term effectiveness of works undertaken. Many priority programs are continuing. Figure 3.2 and Table 3.3 shows a summary of works undertaken in the catchment during the period 2005 to 2013.

Numerous unplanned events (fires, drought and flood) occurred during the life of the RRHS. The Program responded post fire and flood by implementing actions to mitigate the risks caused by these unplanned events. The CMA now has a robust process for assessing the impacts and responding to the effects of fire, flood and drought and blackwater and other water related emergencies. The mid-term Addendum clearly identifies the required works necessary to respond to these events.

A sophisticated Statewide MERI program was developed and implemented by the former DSE, now DEPI (Cottingham, Stewardson et al. 2005) to monitor the effectiveness of environmental flows. Numerous identified knowledge gaps have been addressed.

Key Learnings from the Review

Significant knowledge has been gained on the impacts of works and their ability to contribute towards resilience of the system.

The CMA has a robust process for assessing the impacts and responding to the effects of fire, flood and drought and blackwater and other water related emergencies.

Increased knowledge on the costs to reduce risks and length of time for rehabilitation to take effect.

A review of the works and waterway condition undertaken over recent years provides confidence that we are maintaining and improving many elements and reaches of the region's waterways and wetlands.

There is no single program logic table or diagram in the RRHS but it would be a simple exercise to construct a program logic table linking vision, objectives (goals), strategies, assumptions and outcomes. Objectives for each Program are not explicit but could easily be developed based on the information provided in the RRHS 2004-2013.

Priorities were developed using the DSE approved method i.e. RiVERS[2]. In most cases the priorities determined using this method appeared sensible and have stood the test of time.

A range of risks have been identified and managed. Key environmental threats to high value assets in High Priority Reaches were identified using a risk based analysis. These threats determined the range of management actions to be implemented in various parts of the catchment.

RiVERS enables a risk-based assessment by linking values to threats, and rating the likelihood and consequence of the threat impacting on the value

Development of original RRHS was undertaken with many consultative activities. Community input during implementation was initially via Implementation Committees and then via updated CMA community engagement structures.

Numerous knowledge gaps were identified on which a number have been addressed.

The Regional Waterway Strategy has been prepared against a backdrop of: Shifting focus of partner organisations; Changed investment models; new plans and policies; and Changing capacity of community groups to support the implementation of the Strategy.

Table 3.3 - Achievements 2004 – 2014 (Summary)

6400 ha of fencing to protect river frontages
300 ha of wetland fringes protected through fencing
58 km of priority waterways opened to improved fish passage
1850 hectares of revegetation undertaken in partnership with the community
4 urban stormwater improvement programs undertaken with local government
Community based Waterwatch and Riverconnect programs supported
900 km of aquatic weeds controlled and 24,000ha of riparian weeds controlled
For further information See Appendix J.

Fencing the Acheron River protects stock.

Taggerty beef producers David and Heather McLaren say they have no regrets about fencing off 1.7 km of Acheron River frontage on their 150 ha property on the outskirts of the township.

Initially, when looking for a rural property, due to previous experience, a major consideration was the availability of water, with a preference for river frontage.

The property on the Acheron River seemed ideal, however, management of river frontages came with some perceived problems - some banks would be unstable, there would be places where stock could cross to the neighbouring property periodic flooding, and some section of frontage was Crown land. A key driver for frontage fencing followed the loss of stock into the river due to the unstable banks.

Mr McLaren's desire to fence off the river coincided with an approach from the Goulburn Broken Catchment Management Authority (CMA) to do likewise.

"We readily agreed to this project and have no regrets whatsoever for having done so," Mr McLaren said. "The works have been staged over a five year period with the last section fenced and revegetated in 2010. We no longer play host to the neighbour's cattle from the other side of the river and we no longer have the worry of our cattle falling in the river. Loss of grazing land not in regular use was inconsequential. "

Mr McLaren has also observed that stock preferred to drink from the troughs now in place, rather than any other source of water.

[2] RiVERS: is a database application developed for the Victorian Catchment Management Authorities to assist in developing their Regional River Health Strategies and prioritising waterway management activities using a risk-based management approach

Before and After Images Rehabilitation Works): Tahbilk Fish Passage, crossing modification (Simon Casanelia), Broken River (Flood Recovery) G Brennan (GB CMA), Goulburn River Recreational Fishing Licence project (S Kosch GB CMA), Broken River (bank protection) G Brennan (GB CMA)

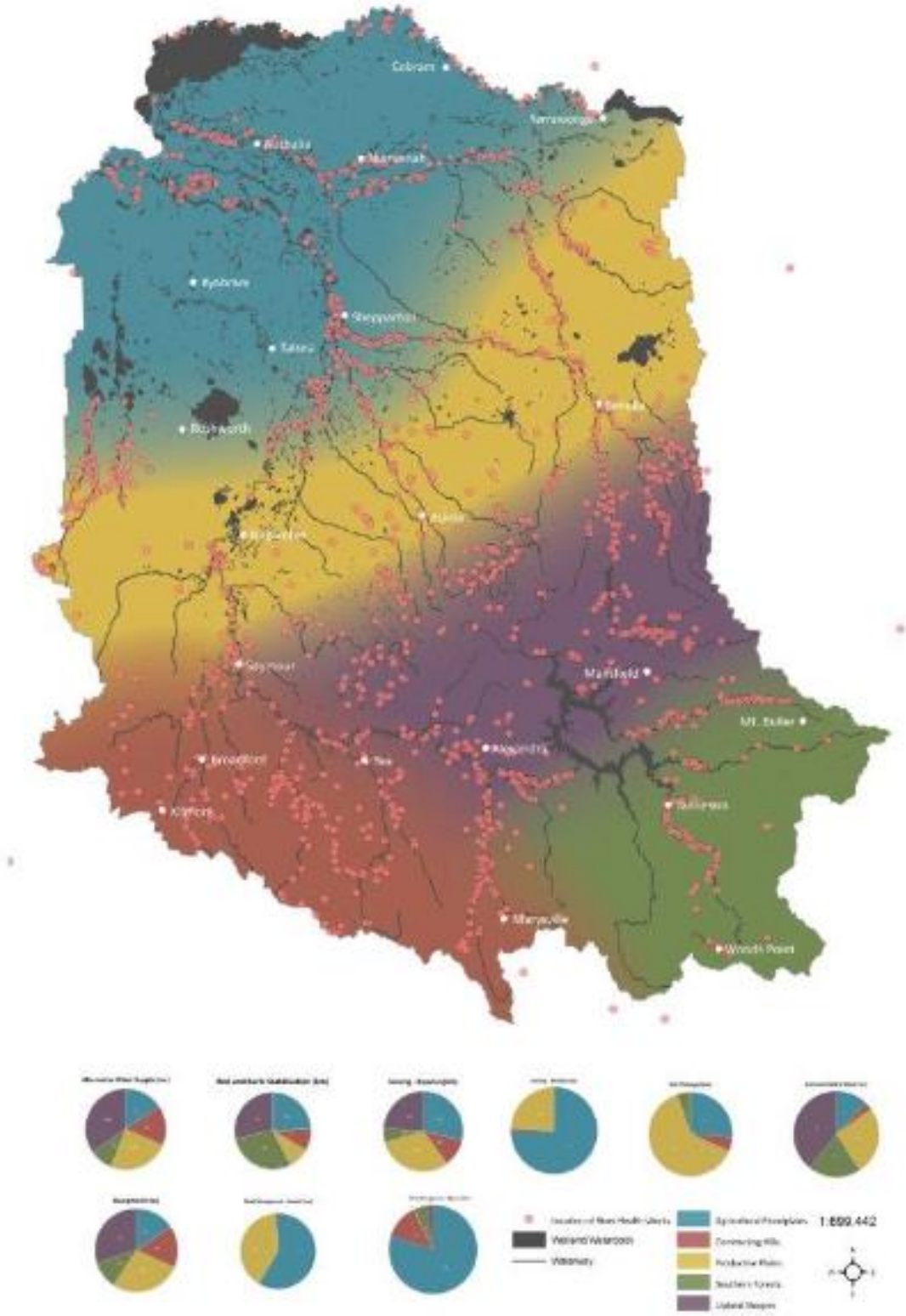

Figure 3.2 - Location of river health works 2005 to 2013

CHAPTER FOUR:

Challenges and Opportunities

This Chapter:

Identifies the key Strategic Challenges and Opportunities; and
Sets the Framework and Actions for Priority Strategic Management Issues

This Waterway Strategy is the detailed, regional planning document for waterway management for the Goulburn Broken Region. The Strategy presents a high level regional work program to guide investment over an eight-year period (See Chapter 7) as part of this it identifies the major strategic opportunities and challenges facing waterway management in the region.

The Victorian Waterway Management Strategy details the state-wide approach to Key Management Issues and identifies state-wide actions for implementation.

This Chapter outlines the background, principles, policies and actions for specific waterway management issues relating to the Opportunities and Challenges[3] facing the management of waterways within the Goulburn Broken Region:

Chapter	Challenge and Opportunity
4.1	Management of Riparian Land
4.2	Water Quality
4.3	Management of the Environmental Water Reserve
4.4	Groundwater
4.5	Floodplain Management
4.6	Public Infrastructure
4.7	Management of Threatened Aquatic Dependent Species
4.8	Management of Recreational Fisheries
4.9	Management of Invasive Species
4.10	Management of the River Channel
4.11	Management of Extreme Events
4.12	Influence of the Surrounding Catchment
4.13	Planning for Climate Change
4.14	Management and Use of Water Storages

[3] It is acknowledged that many other Challenges and Opportunities could be considered within this Waterway Strategy, and is not an exhaustive list. The Challenges and Opportunities listed are considered to be a priority at the time of preparing this Strategy. However within an adaptive framework, other challenges may be identified and addressed over the life of this strategy.

4.1 MANAGEMENT OF RIPARIAN LAND

The purpose of this Chapter is provide strategic direction for the management of the riparian zone which contributes significantly to the condition and resilience of values contained within waterway and wetland systems.

Riparian land is the land that adjoins waterways (rivers, creeks and wetlands). Its management plays a major role in the overall condition of a waterway. The capacity of riparian land to support a healthy waterway system and to contribute to supporting the values associated with adjacent land relies on its condition - width, connectivity and structure of the vegetation present. Good riparian land contributes towards channel stability, supplies of organic matter to waterways, filters light, filters pollutants from the surrounding catchment and contributes to the health and values of the neighbouring land.

Riparian land also has a range of important values. The land is highly valued for production, is home to an array of threatened plant and animal species and is a site for recreation, tourism, cultural and heritage values.

The objective of this strategy for the management of riparian land is: ***To maintain or improve the resilience of riparian land as a key contributor to the condition and health of the region's waterways and wetlands.*** This chapter explores how riparian land can best be managed to work towards realising this objective.

4.1.1 FUNCTIONS OF RIPARIAN LAND

Riparian land is important because it is often the most fertile and productive part of the landscape, in terms of both agricultural production and natural ecosystems. It often has deeper and better quality soils, and supports a higher diversity of plants and animals than the surrounding land. Many native plants are found only, or primarily, in riparian areas, and these areas are also essential to many terrestrial and aquatic animals for all or part of their lifecycle, and it provides important refuge during times of drought.

Riparian land provides support for the many social (including cultural) economic and environmental values we associate with our waterways.

4.1.2 RIPARIAN LAND OWNERSHIP AND MANAGEMENT

Riparian management should be seen as one part, albeit a very important part, of sound management throughout a property and at other larger scales, such as sub catchments and catchments. Even the best management of riparian land will not overcome management practices elsewhere that lead to excessive soil erosion, off-site loss of nutrients and other contaminants (Australian River Restoration Centre website).

In the Goulburn Broken Region there a number of organisations and individuals responsible for riparian land management (See Table 4.1)

Table 4.1 - Organisations and individuals responsible for riparian land management

Organisation	Roles and Responsibilities
Department of Environment and Primary Industries (DEPI)	Overall management responsibility for Crown frontages in Victoria. It is responsible for their administration, including their licensing for riparian management and for grazing and ensuring compliance with licence conditions. The DEPI also has a direct on-ground responsibility for unlicensed Crown frontages.
Parks Victoria	Responsible for areas of delegated management which include riparian areas, examples include Barmah National Park, Broken Boosey State Park.
Waterway managers (Goulburn Broken Catchment Management Authority)	Responsible for working with community and land managers to maintain and improve riparian land for environmental, social, cultural and economic benefits
Private Landholders	Responsible for the management of both private and licenced crown water frontages, associated with their titles
Committees of Management, local government	The typical focus for this management is the protection of high environmental and social values. Also, much riparian land in urban settings is managed by local

	councils, as committees of management, with the principal focus being on enhancing social values.
Landcare and Conservation Management Networks	Assisting community, landholders and other agencies in riparian management
Traditional Owners	Management on Crown land, particularly through joint and co-operative management agreements (see Chapter 2.7)

Victoria has a unique network of public riparian land known as Crown frontages (owned by the State), which were mostly established between the 1850s and the 1880s in recognition of their value as a public resource. Crown frontages occur mostly on larger waterways. On smaller waterways in agricultural landscapes, riparian land is usually privately owned. Of an estimated 85,000 km of rivers and creeks in Victoria (therefore about 170,000 km of frontage), there are about 30,000 km of Crown frontages.

About 22,000 km of the Crown frontages are within cleared catchments (the other 8,000km are in larger public land blocks such as parks and State forests). Crown frontage can vary from a few metres wide to kilometres wide, with the average width being about 20 to 40 metres. The total area of Crown frontage in the state is about 100,000 ha, which is only 0.4% of the State and 1.1% of the total public land estate4. At present, about 17,000 km of the 22,000 km of Crown frontages within cleared catchments are managed by the adjacent landholder under about 10,000 agricultural licences. Most of the licences are for grazing purposes, with a small and diminishing number for the cultivation of crops. These licences are typically renewed every five years, with the next renewal scheduled for October 2014. The average licence fee is $85 for five years, calculated on productive value of the land but discounted based on weed management and other obligations on the licensee. (DEPI, 2013). For further information on crown water frontages see: http://www.dse.vic.gov.au/__data/assets/pdf_file/0004/138982/Crown-Land-Water-Frontages-Factsheet.pdf

4.1.3 MANAGEMENT OF RIPARIAN LAND

For the purpose of this strategy, healthy riparian vegetation is defined as: that representing the naturally occurring range of species, is self-sustaining, resilient, in good condition and capable of providing an appropriate level of support to the range of values within the waterway

Riparian vegetation is an important part of the terrestrial landscape. It acts as a refuge during dry times, can be the largest remnant of native vegetation in cleared catchments and acts as a wildlife corridor linking habitats, particularly in areas of high production where much of the terrestrial native vegetation has been cleared. Landscapes that contain waterways with remnant vegetation have been shown to have a greater diversity for aquatic and terrestrial birds than those without a waterway.

Healthy riparian vegetation

Health riparian vegetation plays many important roles, including;

- Maintaining and improving water quality, by filtering out sediments, nutrients and pathogens from run-off from a range of land uses and catchment activities including agriculture, on-site domestic wastewater management and urban development. This protects public water supplies, improves water quality for fishing and recreation and helps reduce algal blooms downstream
- Maintaining bank stability therefore reducing erosion
- Regulating in-stream primary production through shading which can benefit fish, and reduce the likelihood of algal blooms
- Storing carbon
- Supplying energy and nutrients to associated wildlife; and
- Providing essential aquatic habitat through fallen logs, leaves and other plant material. For example, wood that falls into waterways results in deep holes and protection from predation for native fish species.
- Maintaining the integrity of the waterway through tree roots preventing undercutting of banks (ARRC web site, DEPI 2013).

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The 'Index of Stream Condition' (DSE 2010) has been used to assess 117 reaches in the Goulburn Broken Catchment. Results from these assessments showed the entire range of indices for the health of reaches from 'reference' condition to 'poor' condition. Overall, the majority of reaches (62% in both the Broken and Goulburn basins) were in good or excellent condition. Sixteen of the 117 reaches assessed across the region were in excellent condition, with the majority of these located in the Goulburn basin. Notably, reaches 63, 66 and 67-68 (on the Acheron, Rubicon and Big Rivers respectively) in the heavily vegetated highlands of the Goulburn basin were in reference condition. The lowest and upper reaches of the Goulburn, Dabyminga, Yea, Murrindindi, Taggerty, Howqua and Delatite Rivers were in near reference condition (reaches 1, 15-16, 50, 57, 59, 64, 70 and 72 respectively).

The health of reaches reflected associated land use, with reaches in reference condition located in the reserves and uncleared land in the south of the catchment and those in poor condition were located in areas where associated riparian and surrounding land had been cleared. For further information see: http://www.depi.vic.gov.au/water/water-resource-reporting/Third-Index-of-Stream-Condition-report

Weeds

Weeds are an important management issue to consider because they displace native species, affecting both the biological and physical processes of ecosystems. Single species can dominate the riparian zone reducing biodiversity and the associated native animals as weeds rarely provide suitable habitat. Different weed species have different impacts. For example, transformer species, eg broom, blackberries, tree willows and shrub willows, often form dense infestations, and have significant impacts on many ecosystem processes, such as provision of habitat and natural regeneration of native species.

Scrambling species have the potential to severely affect the growth and health of native vegetation (eg Cape ivy and English ivy) by smothering native plants and trees. In contrast, other species such as some flatweeds and Yorkshire fog grass, although common in riparian areas, rarely form dense infestations and generally appear to have relatively little impact on either biological or physical processes.

Riparian areas are particularly susceptible to weed invasion and are often invaded by multiple weed species. This susceptibility to invasion is a result of the natural disturbance processes associated with flooding, favourable environmental conditions and the continued input of weed propagules from upstream and surrounding land. The impacts of human activities have also increased the likelihood of weeds establishing in riparian areas. However, well designed weed management programs can achieve positive outcomes in riparian areas (Ede, F.J. and Hunt T.D. 2008).

Weeds in riparian areas may:

- change vegetation community composition
- inhibit recruitment and growth of native plant species
- decrease food and habitat for native fauna, both terrestrial and aquatic
- change aquatic food webs
- provide food and habitat for exotic animals such as foxes and blackbirds
- change soil nutrient processes
- decrease water quality
- change sedimentation, erosion and hydrological processes
- decrease water quantity (eg willows)
- change water temperature and light conditions by overshading the waterway
- reduce access and recreational opportunities (Ede, F.J. and Hunt T.D. 2008).

Land managers are currently required to manage certain pest plants and animals under the *Catchment and Land Protection Act 1994* for private riparian land and through licence conditions for Crown Frontages. These include blackberries, willows, desert ash, etc.

Willows

Willows are now regarded as one of the most serious riparian weeds in Australia, listed as one of Australia 20 Weeds of National Significance (Holland Clift & Davies 2007). In decades past willows were used in waterway management to combat bank erosion. It is now understood that the negatives impact of willows in and along waterways far outweighs the positives. Within the Goulburn Broken Catchment it is considered a series weed in a number of parts of the catchment (upper Goulburn and tributaries, mid Broken River, Hollands and Ryans Creeks)

Impacts of willows in waterways include;

- Increased erosion and flooding
- Reduced quality and flow of water
- Reduced availability of water
- Less habitat available for fish, birds, frogs, insects, mammals and reptiles
- Obstructing access to streams for fishing and aquatic activities
- Damage to nearby infrastructure (Holland Clift & Davies 2007).

For further information see http://www.weeds.org.au/WoNS/willows/

The GB CMA will work in a voluntary and co-operative approach with land managers to manage weeds including willow and blackberry infestations to improve the condition of the region's waterways.

Stock and waterways

Stock access can have a detrimental impact on the health of a waterway and present risks to human health.

Uncontrolled stock access (timing, duration, intensity and type) has an impact of the health / condition of riparian lands. Impacts include;

- Pugging and reducing grass cover, resulting in increased sediment and nutrient runoff to a waterway
- Restricting regeneration of native vegetation, reducing its ability to maintain waterway health
- Increased erosion
- Reduction in habitat for native fauna
- Soil compaction
- Increased weed invasion into the riparian zone.

There are many landholder benefits to restricting stock access to waterways. These include;

- Reduced erosion
- Reduced stock losses
- Controlled water quality for livestock which may improve stock health
- Improved stock manageability
- Benefits to the broader community through reduced pollution in waterways, downstream of the stock access area.

For further information see: http://lwa.gov.au/files/products/river-landscapes/pr061132/pr061132.pdf

A major challenge in construction of fencing in riparian and flood plain areas is designing for floods. Even with improving designs to minimise flood damage this is remains a major challenge.

Research has shown that stock accessing waterways upstream of drinking water offtakes possess a significant risk to human health. More recently the Victorian Department of Health commissioned a report to look at this issue which found there is a significant risk in allowing stock access.

For a full report see:
http://docs.health.vic.gov.au/docs/doc/538F80E02C3D7835CA2579D6000E6050/$FILE/Stock%20Risk%20Assessment%20-%20final%20report.pdf

The GB CMA will work with water authorities and landholders in a voluntary but targeted approach to reduce stock access to waterways upstream of drinking water off takes.

Access to Stock Water

Removing or controlling grazing results in the issue of stock access to water. Having a private frontage or traditional Crown frontage licence means a land managers stock are allowed direct access to the stream or river as a source of water. If landholders hold a riparian management licence and the area is fenced to prevent stock access to the waterway, a take and use licence is available from Goulburn Murray Water to access water for stock (if the land manager does not already have a take and use licence or the volume of the existing water licence is not adequate for the stock's water needs). In this case, water does not need to be purchased on the water market, but an application fee and annual renewal fee may apply. Grants are available for assistance in funding alternative water supplies.

For further information see: http://lwa.gov.au/files/products/river-landscapes/pr061132/pr061132.pdf and http://www.depi.vic.gov.au/water/rivers-estuaries-and-wetlands/implementation-and-monitoring/managing-grazing-on-riparian-land

The GB CMA will work with landholders who want to improve the condition of their frontage and establish a specific controlled grazing regime relevant to their frontage where appropriate.

Where land managers have fenced off an existing licenced crown water frontage (and transferred the licence to a riparian management licence and require stock water the GB CMA will facilitate a process with G-MW to obtain a licence and volume for the landholder:

NOTE some ongoing cost will be need to be borne by the landholder

Fire

A common misconception is that good condition or well vegetated riparian areas pose a significant fire risk. These areas actually pose a lower fires threat to assets than the threat posed by other parts of the landscape (DEPI 2013b). A well vegetated riparian zone retains moisture, provides fire refuge areas for wildlife.

State-wide policy relating to fire and riparian land management is shown within Chapter 9.3.1 of the VWMS. (DEPI 2013b)

Access to riparian areas for recreation

Of the 10,000 odd kilometres of streams in the Goulburn Broken Regions, 4760km have Crown Water Frontage abutting them. Where a Crown land water frontage exists the public has the right to enter and remain on the land for certain recreational purposes such as walking, fishing or bird watching. Members of the public should not interfere with the purpose of any licenced frontage and are not permitted to camp or light fires on licensed Crown land water frontages.

Environmental and productivity benefits of good management

Good management of riparian areas can have positive environmental and productivity benefits. One way to plan well for multiple benefits at the property scale is develop a whole farm plan.

Production	Environmental	Social
• Management of Grazing • Access to water for stock • Maintain channel stability • Shelter belts • Management of pests (through wildlife)	• Protection of threatened species (Flora and Fauna) • Protection of water quality • Maintain channel stability • carbon sequestration	• Improved drinking water quality • public access • recreation and tourism • cultural heritage values • Maintain channel stability

One way to plan well for multiple benefits at the property scale is develop a whole farm plan. (refer to Chapter 4.12.3)

Partnering with land managers to improve condition

The VWMS outlines the state-wide approach to improved riparian management, and discusses the need for voluntary and co-operative partnerships between land managers and government agencies. The GB CMA will assist in improving riparian management by providing information and investment for the improvement of riparian condition.

Typical activities where investment assistance from the Goulburn Broken CMA can be provided include:

- *Fencing* to remove uncontrolled stock grazing on riparian zones. The state wide policy states that where such government investment is applied fencing "will aim to be at least 20 m wide on average from the top of the bank and must not be narrower than 10 m in any one place"
- *Revegetation or natural regeneration*, through practices such as tube stock planting, direct seeding and management aimed at allowing natural regeneration.
- *Pest plant and animal management*. Landholders are currently required to manage certain pest plants and animals under the *Catchment and Land Protection Act 1994* for private riparian land and through licence conditions for Crown frontages.
- *Off stream watering infrastructure*

The investment in riparian management by the State Government (DEPI, 2013b) will be targeted to priority activities that are determined through the Regional Waterway Strategy which will identifies high value waterways and establish priority riparian management activities (see Chapter 7). It is also important to align the management action with the key threats and threatening process (GHD, 2012) and Chapter 6.7

Riparian Management Agreements

Partnering with land managers will involve voluntary riparian management agreements (for Crown and private land) and licence arrangements with (adjoining) landholders. These agreements will be legally binding agreements that set out management actions and responsibilities

Riparian Management Licences

A riparian management licence for a Crown water frontage recognises that all or part of the frontage is being managed by a licensee to protect and improve the riparian environment (e.g. fenced out and supporting native vegetation). A riparian management licence is typically generated through the conversion of an existing grazing licence as part of an agreement between a landholder and the Goulburn Broken (CMA) for undertaking riparian protection and improvement works such as fencing and revegetation. The long-term management responsibilities agreed to by the landholder in the CMA agreement are incorporated as special conditions into a riparian management licence. These special conditions remain with the licence which may be transferred if the adjacent private land changes hands. Licences are generally renewed every five years. Many projects on Crown land that include fencing to manage stock access to a waterway qualify for a riparian management licence e.g. CMA, Landcare or privately funded projects (DEPI 2013b).

The GB CMA will work in a voluntary and co-operative approach to change licence agreements, with land managers, who undertake activities to improve the resilience of the region's priority riparian lands.

4.1.4 STRATEGIC RIPARIAN ACTIONS

The following Table details Strategic Actions for implementation over the next eight years:

Action	Timeframe	Responsibility
Undertake strategic revegetation on priority waterways, wetlands and floodplains to maintain and improve the resilience of targeted waterways	2013 - 2021	GB CMA, Landowners
Link strategic land management actions to key (priority) riparian management programs within areas that contribute to waterway resilience.	2013 - 2021	GB CMA, DEPI (region), Landcare and Landowners

4.2 WATER QUALITY

Development of the Goulburn Broken Water Quality Strategy commenced in 1994. The Strategy aimed to reduce potential catchment Total Phosphorus (TP) loads exported from the catchment by 65% (from an estimated 371 t of TP) with the aim of reducing the risk and incidence of blue green algal events. Implementation began in 1996. A review of the Strategy and its implementation was commissioned in 2007. Overall, a substantial reduction in TP export from the catchment has been achieved. Analyses of trends generally show improving or stable water quality conditions. The review highlighted "new" issues to be addressed including climate change impacts on water quality. Implementation of the Strategy improves the resilience of the catchments streams and water bodies.

4.2.1 REVIEW PROCESS

In 2007 a review of the Goulburn Broken Water Quality Strategy was commissioned by the Goulburn Broken Catchment Management Authority (CMA) (Feehan Consulting 2008). The initial strategy had been in implementation for a decade and new and emerging water quality issues were present.

The aim of the water quality strategy (1996) was "to improve and maintain water quality at optimum levels within and downstream of the catchment for native ecosystems, recreation, human and animal consumption, agriculture and industry."

The first step in this review process was an examination of the outcomes from the efforts, by the community, towards the goals stated in the Strategy. It was not a detailed review exercise.

A further review was undertaken in 2010 which underwent a detailed assessment of the Strategy's performance. The review identified new water quality issues for the community to focus on: pathogens, sedimentation, impacts of catastrophic events and impacts of development pressure.

The current aim is "to maintain and enhance water quality for the range beneficial uses (values)."

4.2.2 LESSONS LEARNT

A number of key lessons have emerged from the process of implementing the water quality strategy:

- Community understanding and involvement (key sectors of the community and industry) in strategy preparation and implementation was critical.

Regional partnership agreement for managing water quality incidents in the Goulburn Broken region

A partnership agreement for managing water quality incidents was established in 2007 by key agencies with regulatory or functional responsibilities for waterways in the Goulburn Broken region. The 'Partnership Agreement for Preparedness and Response to Waterway Incidents in the Goulburn Broken Catchment' clearly outlines roles and responsibilities for responding to regional waterway incidents and is signed by the Department of Sustainability and Environment, the Environment Protection Authority Victoria, the Goulburn Broken Catchment Management Authority, Goulburn-Murray Water, Goulburn Valley Region Water Corporation, North East Region Water Corporation and Department of Health.

The agreement provides a regional framework for response and recovery from waterway incidents that are not covered by existing arrangements. The intent of the agreement was to clearly establish the framework for leadership, and provide guidance in operations, communications and investigation of waterway incidents. This was considered essential to ensure a co-ordinated approach and to maintain the confidence of the community while all agencies carry out their respective roles in protecting, restoring and maintaining water quality of waterways.

In support of the agreement, a Water and River Contingency Planning Group was also established for the region that considers a range of waterway and water quality issues, including fish death incidents. This group meets on a regular basis throughout the year, and more frequently when risks to waterways increase.

The agreement has provided useful guidance during dry inflow conditions (that were experienced during the drought) and for managing water quality incidents such as low dissolved oxygen, blackwater and fish deaths that were caused by regional flooding.

- Working out what is important – our process helped determine the key issues (in the case study areas and nutrient management).
- Working with imperfect knowledge – these processes never have perfect knowledge – we had to state our assumptions and move on. We have been able to test our assumptions over time. Many of the assumptions have been monitored and proven adequate.
- Availability of data – the Goulburn Broken catchment is considered to be "data rich". Even so, data was not available to investigate all questions. We could not wait for data to become available.
- Setting targets – target setting is an imperfect process. Our approach, of setting targets is based on best management practices (BMPs) worked well for us.
- Monitoring of water quality parameters is relatively straight forward. Monitoring of BMP implementation is very difficult.
- Integration with other programs – achieving implementation by using other programs already established in the catchment has worked well and reduced overlap and duplication and increased investment.

4.2.3 IMPLEMENTATION

Development of an integrated and coordinated water quality strategy for the Goulburn Broken catchment has been completed and implementation is progressing. Substantial reductions of nutrient outputs from major sources have been achieved, but it is too early to determine whether objectives are being met or will continue to be met.

However, the Goulburn Broken WQS is considered, by the Regional Water Quality Forum, the correct approach for delivering improvement in water quality (nutrients) within the region.

The Goulburn Broken Water Quality Co-ordination Group

The Goulburn Broken Water Quality Co-Ordination Group, in the context of regional water quality, aims to ensure all relevant partners understand what is being achieved and how their component and activities fit towards achieving water quality goals for the region. The meetings provide a mechanism for regional consideration of relevant issues. The group will focus, at a strategic level, on: technical and science issues, communication and facilitation, coordination and information sharing and aligning activities to relevant strategies.

The region has established a Regional Water and Contingency Planning Group which assesses risks and responds to waterway incidents.

Members of the above Groups include (not limited to): Department of Environment and Primary Industry, the Environment Protection Authority Victoria, the Goulburn Broken Catchment Management Authority, Goulburn-Murray Water, Goulburn Valley Region Water Authority, North East Region Water Authority; representatives from local government, Waterwatch, the Regional Water Monitoring Partnership and the Department of Health.

4.2.4 STRATEGIC APPROACH

- Involve the community in water quality issues (planning, implementation and monitoring)
- Implement an adaptive management approach and measure the change in resilience.
- Determine, understand and address the key issues
- Advance our knowledge in general (including impact of climate change)
- Continue to improve our knowledge base (data, risks, adaptive management)
- Use best available data and knowledge – acknowledge that this could be imperfect
- Set and monitor appropriate targets.
- Integrate water quality activities with other programs and stakeholders (agencies and community) via partnership approaches
- Maintain sufficient investment

4.2.5 STRATEGIC PRIORITIES

The Goulburn Broken Water Quality Co-ordination Group completed a review of strategic priorities in mid-2012. Strategic priorities are shown in Table 4.2

The Group assessed regional water quality issues with the aim of developing a works program to be addressed by the Group, and their respective organisations, over time.

Table 4.2 - Strategic Priorities (2012):

Strategic Priority	Why is it a priority	What is the key Action to be done?
Land Development and Planning	Source of human infectious organisms (pathogens)	Development, implementation and monitoring of domestic wastewater management plans across the region
Sewerage Scheme Planning/ Onsite Waste Water Management	Source of sediment and turbidity and nutrients	Assess priority development zones for their impact on beneficial uses. Ensure adequate sewerage management (demand/need) strategies exist to for existing townships and development areas. Assessment impacts of diffuse sources across the region and develop risk assessment and mitigation activities for beneficial uses. Ensure effective use of existing planning controls and implementation of "best practice"
Partnerships	A means of managing water quality issues in the catchment	Maintain and support Regional Water Quality Forum and River and Water Contigency Group (Waterway Incidents). Support Northern Water Quality Monitoring Partnership.
Source and Fate of Pollutants	Helps us understand how pollutants are sourced, transported and can be managed.	Assess the risk posed to beneficial uses (surface and subsurface) from key pollutants (pathogens, nutrients, sediments). Develop and implement programs to address high risk areas and pollutants. Maintain links with research providers.
Riparian Land Management	Riparian land can be a source of pollutants (especially sediment, turbidity and human infectious organisms).	Accelerate the level of riparian maintenance "best practice" initiatives.
		Support Policy 9.6 from the draft Victorian Waterway Management Strategy, which relates to addressing pathogen risks from stock accessing waterways upstream of drinking water offtakes,

4.2.6 STRATEGIC WATER QUALITY ACTIONS

The following Table details Strategic Actions for implementation over the next eight years:

Action	Timeframe	Responsibility
Development of domestic wastewater management plans across the region	2015	OLV, DEPI, Local Government
Development, implementation and monitoring of domestic wastewater management plans across the region	2016-2021	OLV, DEPI, Local Government
Continue to support "Waterwatch" within the Region	2015-2021	GBRWQF
Maintain and support Regional Water Quality Forum and River and Water Planning Group. Support Northern Water Quality Monitoring Partnership	2013 - 2021	All
Assess the risk posed to beneficial uses (surface and subsurface) from key pollutants (pathogens, nutrients, sediments).	2013 - 2021	GB CMA (Waterway Manager)
Assess pathogen risks from stock accessing waterways upstream of drinking water offtakes, as part of riparian management programs, in line with Policy 9.6 of the Victorian Waterway Management Strategy	2016	GB CMA

4.3 MANAGEMENT OF THE ENVIRONMENTAL WATER RESERVE

Environmental water management aims to manage/restore components of flow regimes in rivers and watering regimes in wetlands to maintain and improve their resilience. Natural flow and watering regimes have been heavily impacted by river regulation and water consumption, and by artificial barriers which reduce wetlands access to their natural source of water.

During the life of the 2004 River Health Strategy, environmental water management has developed dramatically. Major government policy initiatives have been developed, including the 2004 Victorian Government White Paper "Securing Our Water future Together", the 2009 Northern Victorian Sustainable Water Strategy, the *Commonwealth Water Act 2007*, and the 2012 Murray-Darling Basin Plan. Environmental water holders have been established by the Victorian and Commonwealth governments, and the Goulburn Broken CMA has been designated as the manager of environmental water in this catchment. The Environmental Water planning process is shown in Figure 4.1 below.

Policy and administrative arrangements will continue to evolve with the implementation of the Murray-Darling Basin Plan through the life of this River Heath Strategy.

Initially, the only managed environmental water was for 500,000 ML for Barmah Forest and 27,500 ML for all Northern Victorian wetlands. Environmental water has subsequently been acquired by the Murray Darling Basin Authority for The Living Murray Program, by the Victorian Government, and by the Commonwealth Government. In the Goulburn system, there is now an additional 265,000 ML of High Reliability Water Shares and 169,000 ML of Low Reliability Water Shares, with similar amounts held in the Victorian Murray supply system. These amounts of water entitlement are adequate to meet the environmental needs of the Goulburn-Broken catchments if only applied for that purpose. However, the Basin Plan currently requires greater volumes to be acquired to provide for all the environmental needs throughout the Murray-Darling Basin.

With significant volumes of environmental water available, environmental flows are now routinely being planned and managed in the Barmah Forest, the lower Goulburn River, the lower Broken Creek, the upper Broken Creek, and various wetlands.

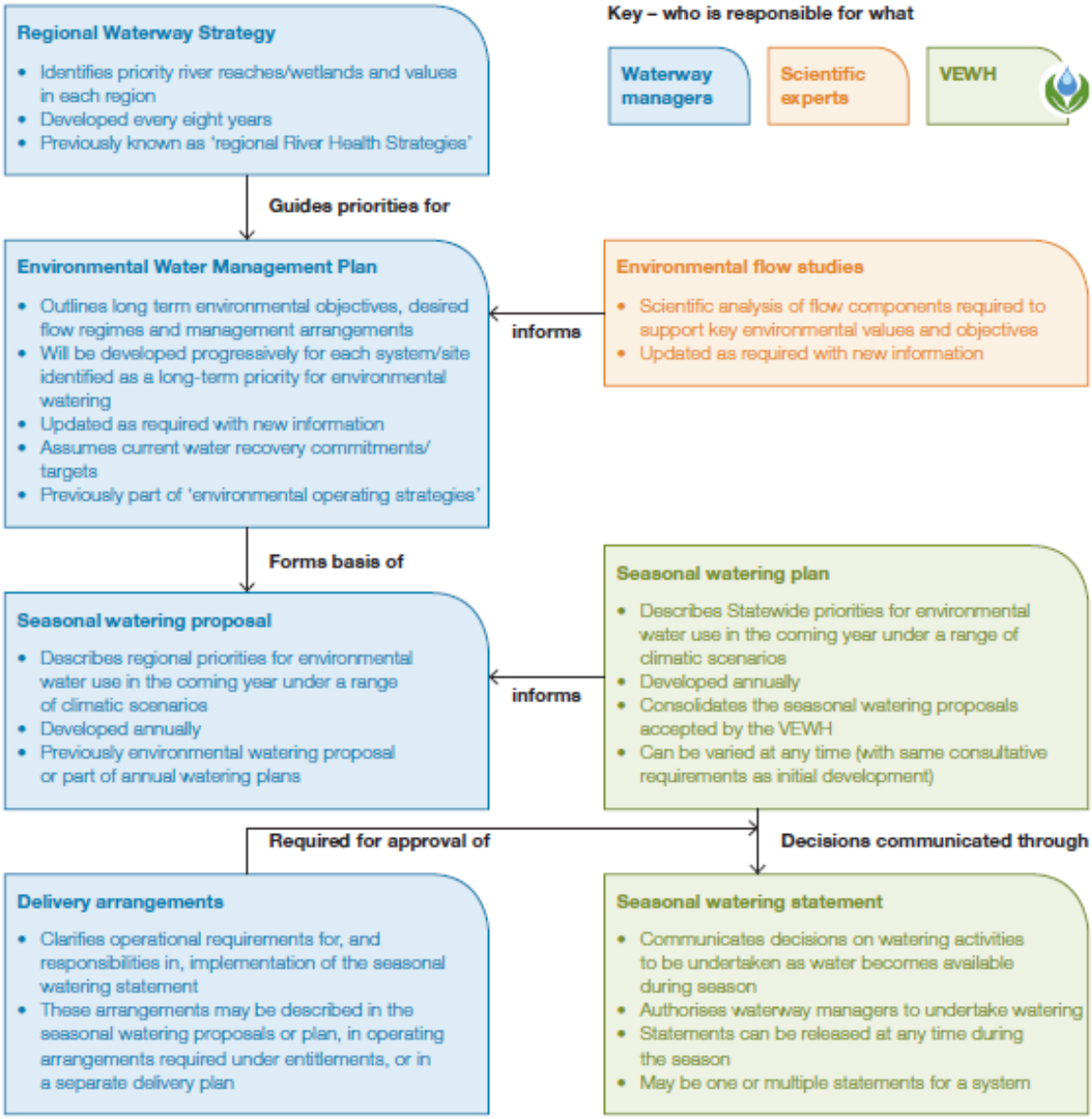


Figure 4.1 – The Environmental Water planning process (from DEPI, 2013b)

4.3.1 PRIORITY WATERWAYS AND WETLANDS

Barmah Forest, a Ramsar-listed wetland system on the Murray River floodplain, has extensive red gum forests and wetlands providing critical habitat for waterbirds, fish, and a range of other animals. It has much reduced winter/spring flooding flows, and has frequently low level summer-autumn flooding.

The lower and mid Goulburn River and its associated floodplain and wetland habitats support intact river red gum forest, and numerous threatened species such as Murray cod, Trout cod and Macquarie perch. It is the most flow altered stream in the catchment due to water harvesting and water delivery for irrigation. It has two key reaches. The first is between Lake Eildon and Goulburn Weir where summer flows are high (and usually cold water) and winter flows are lower. The second is between Goulburn Weir and the Murray River where both summer and winter flows are reduced.

Lower Broken Creek is a highly modified natural waterway with significant environmental values including large bodied native fish, and severe water quality problems (low DO, and azolla blooms).

Wetlands, both along watercourses and isolated on the riverine plains have a variety of environmental values, and are also priorities for improved flow management.

Several unregulated streams throughout the catchment are also priorities, although active flow management is not possible, as there are no upsteream storages where water can be accessed and delivered..

4.3.2 MANAGEMENT OBJECTIVES

Management objectives have been set for all priority waterways and wetlands. Environmental flow studies have been completed for the Goulburn River, the Broken River, the upper and lower Broken Creek, Sevens Creek, Yea River and King Parrot Creek. Wetland Management Plans are available for all priority wetlands, including Barmah Forest, Reedy Swamp, Black Swamp, Kinnairds Swamp, Moodies Swamp, Doctors Swamp, Gaynor Swamp, One Tree Swamp, Two tree Swamp, Wallenjoe Swamp, and Mansfield Swamp

4.3.3 STRATEGIC APPROACH

Adaptive management of environmental flows is critical, given the newness of active environmental water management and the evolving scientific understanding of ecological responses to flows.

Environmental monitoring programs and active assessment of the results to understand ecological response is therefore required to drive learning and changes in flow management.

As required, environmental objectives and flow regimes need to be periodically updated to reflect knowledge gained.

Annual water planning should continue to prioritise water use between objectives at a site under variable climatic conditions and between sites, including within multi-year planning frameworks considering the risks of long term climate scenarios.

Where environmental water cannot be applied to high value environmental sites, options for works or other changes to allow it to occur will be developed. Where environmental flows in streams and wetlands cannot be directly managed, improved flow management will be pursued.

Community involvement in managing environmental water, and in understanding the purposes and outcomes of environmental water management, can significantly improve environmental outcomes and is critical to long term successful outcomes.

Management of non-flow threats to environmental assets will occur with flow management improvements, providing better outcomes than individual threat management.

4.3.5 STRATEGIC PRIORITIES

Given the stored environmental water that has become available for use and the ongoing implementation of the Murray-Darling Basin Plan, the key focus for environmental water management will continue to be the regulated water supply systems and the environmental assets that can be supplied from them.

A key priority is the continued development of management frameworks and practices and capabilities, and the updating of those that are or become out-of-date.

Adaptive management based on applying environmental water and understanding the outcomes from its use will be critical to building knowledge to maximise the long term benefits from environmental water use.

Community understanding of and involvement in environmental water management will add vital knowledge and value to developing the best long term environmental water management.

4.3.6 STRATEGIC EWR ACTIONS

Action	Timeframe	Responsibility
Support development of environmental monitoring and research programs focussed on key environmental watering priorities (including wetland vegetation), and establish processes to routinely assess results and feed back into future flow management decisions	2021	DEPI, GB CMA ARI, Universities
Re-develop river health and environmental flow objectives for the Goulburn River between Lake Eildon and Goulburn Weir (to accommodate high summer flows and cold water).	2021	GB CMA
Develop Environmental Water Management Plans for The Goulburn River, upper and lower Broken Creek.	2018	GB CMA
Develop a multi-year environmental flow planning framework for the Goulburn River, including compatibility with Murray River environmental flow release needs from the Goulburn River.	2021	GB CMA
Develop an understanding of the issues associated with lower Goulburn floodplain watering to develop options for maximising environmental outcomes while minimising social and economic impacts	2018	GB CMA, DEPI
Develop and implement works and other actions to provide water supply to priority wetland and streams (eg regulators)	2021	GB CMA, DEPI
Understand the potential impacts of environmental flow management on economic and social activities, and minimise impacts where possible.	2021	GB CMA, G-MW, DEPI (policy), RMW
Work with GMW and River Murray Water to maximise the potential environmental outcomes from management of consumptive water en-route and supply system operation flexibility.		
Increase community communication and engagement in environmental flow management.		
Develop a better understanding of groundwater dependent ecosystems and look for opportunities to protect and improve these.		
Continue to develop and implement strategic actions at Barmah Forest.		

4.4 GROUNDWATER

Groundwater resources in the Goulburn-Broken catchment are managed by Goulburn-Murray Water (GMW), in line with the requirements of the *Water Act (1989)* and associated Ministerial policies. GMW has delegated responsibility for licensing bore construction and the take and use of groundwater, to groundwater diverters, and leads the development and implementation of groundwater management plans.

Groundwater management plans have historically been developed to manage areas of intensive groundwater use, designated as Water Supply Protection Areas (WSPAs). These statutory plans have been developed by a ministerially appointed committee (including representation from GBCMA) and endorsed by the Minister for Water.

More recently GMW has been developing groundwater local management plans. The plans typically cover areas of less intensive groundwater use, referred to as groundwater management areas (GMA). Local management plans are developed in consultation with a stakeholder and community reference group and are endorsed by GMW.

Groundwater management plans take into account the potential impact of groundwater extraction on streams, springs, wetlands and other Groundwater Dependent Ecosystems (GDE) s. The current and proposed groundwater management plans for the Goulburn Broken catchment are shown below in Figure 4.2.

State policy and guidance on groundwater planning and licensing matters is provided by the Department of Environment and Primary Industries. Key policy documents include the Northern Region Sustainable Water Strategy (DSE, 2009), and the new Groundwater Framework for Victoria (DSE, 2012).

The Goulburn Broken catchment is part of the Murray-Darling Basin, and groundwater management arrangements are subject to the requirements of the Murray-Darling Basin Plan (MDBP). A key feature of the MDBP is the requirement to develop water resources plans by 2019.

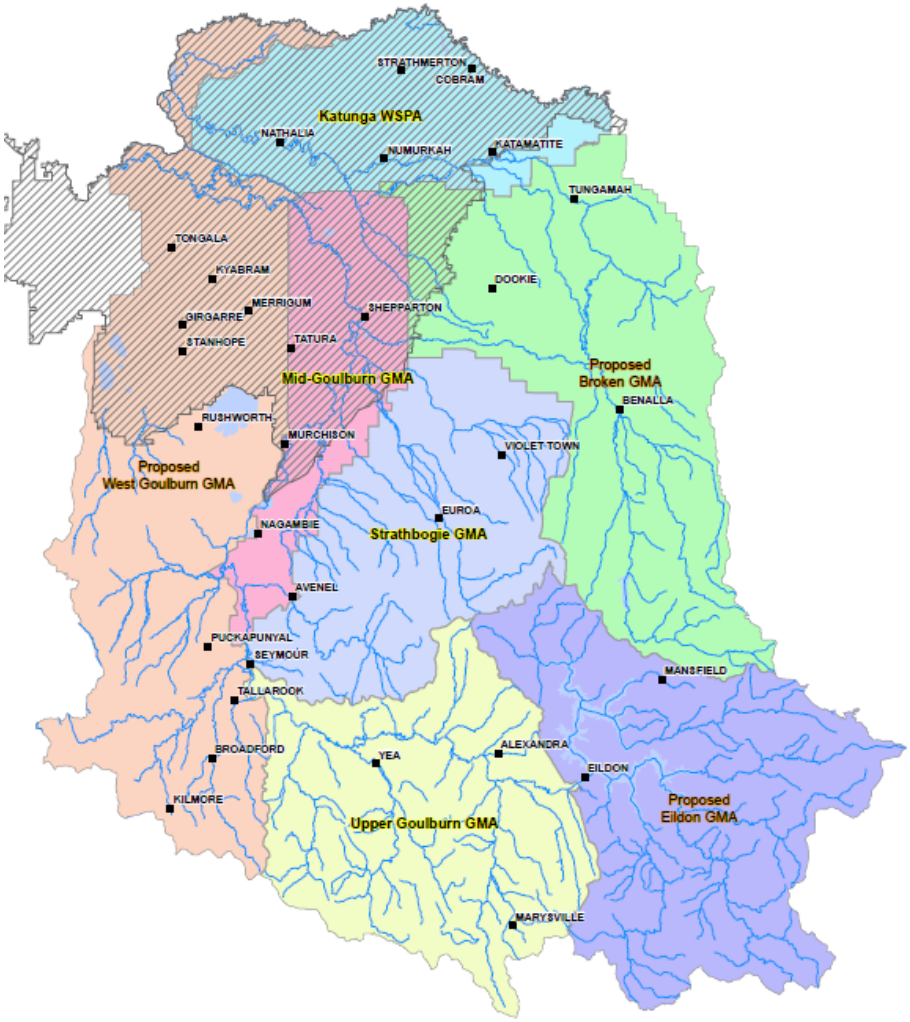


Figure 4.2 - Goulburn Broken Groundwater Management Units (source Goulburn Murray Rural Water Corporation)

4.4.1 GROUNDWATER DEPENDENT ECOSYSTEMS

Groundwater Dependent Ecosystems (GDE's) are ecosystems that rely on groundwater for part or all of their water requirements. Not all GDEs draw on groundwater directly and not all are solely reliant on groundwater. Groundwater commonly provides a key and reliable source of water to an array of important regional ecosystems. As with surface flow, groundwater can be the main factor controlling the distribution of ecosystem types.

Six types of Groundwater Dependent Ecosystems (Geoscience Australia, 2013) have been identified in Australia:

- terrestrial vegetation that relies on the availability of shallow groundwater
- wetlands such as paperbark swamp forests and mound springs
- river baseflow systems where groundwater discharge provides a significant baseflow component to the river
- aquifer and cave ecosystems where life exists independent of sunlight
- terrestrial fauna, both native and introduced species, that rely on groundwater as a source of drinking water

- estuarine and near-shore marine systems, such as coastal mangroves, salt marshes and sea-grass beds, which rely on the submarine discharge of groundwater.

In many cases the groundwater system of the region provides baseflow in rivers and wetlands that many ecosystems depend on. Hence the management of groundwater (see above) its quantity and quality is required so that key GDEs are not impacted upon. GDE management is determined by the degree and nature of their groundwater dependency.

The Groundwater Dependent Ecosystems Atlas (http://www.bom.gov.au/water/groundwater/gde/map.shtml) provides a wide-ranging register of the location and characteristics of groundwater dependent ecosystems within the Goulburn Broken region and across Australia. The Atlas shows ecosystems including springs, wetlands, rivers and vegetation that interact with the subsurface presence of groundwater, or the surface expression of groundwater.

4.4.2 STRATEGIC APPROACH

The strategic approach to groundwater management, in the context of this waterway strategy is to:

- Involve customers, the wider community and other stakeholders in groundwater plan development and implementation
- Determine the resilience, understand, and manage the key environmental issues using a cost effective risk based approach, taking into account social and economic values
- Advance our knowledge in general, and use best available data and knowledge –acknowledging that this could be imperfect
- Integrate with other programs and stakeholders, and align with State, Basin Plan and National Water Initiative requirements

4.4.3 STRATEGIC PRIORITIES

- The strategic priorities for groundwater management, in the context of this water strategy are to:
- Support the development of groundwater management plans across the entire Goulburn Broken catchment
- Identify high value groundwater dependant stream values, and other groundwater dependant ecosystems
- Determine robust environmental flow and groundwater level objectives for priority sites
- Align groundwater and surface water management approaches where this is cost effective and desirable.

4.4.4 STRATEGIC GROUNDWATER ACTIONS

The following Table details Strategic Actions for implementation over the next eight years:

Action	Timeframe	Responsibility
Complete the development of groundwater local management plans for the Upper Goulburn, Strathbogie, West Goulburn, Eildon, Broken, and Mid Goulburn GMAs, taking into account social, economic and environmental values)	Dec 2015	GMW, DEPI stakeholders and community
Review and adapt groundwater management plans to take into account new information when it becomes available	ongoing	GMW
Develop robust flow objectives for all high value steams	2015	GBCMA GMW
Identify and map high value GDEs and groundwater levels or groundwater discharge regimes required to support healthy ecosystems	2015	GBCMA, GMW
Develop ministerial guidance on GDEs and implement this guidance when assessing groundwater licence applications	2014 onwards	DEPI, GMW, GBCMA
Align groundwater management with the outcomes of the water law review and proposed changes to the *Water Act (1989)*	2014 onwards	DEPI, GMW
Assess the viability of conjunctive management of groundwater and surface water in priority catchment(s)	2015 onwards	GMW, GBCMA, DEPI

4.5 FLOODPLAIN MANAGEMENT

The Goulburn Broken CMA coordinates the implementation of its Regional Floodplain Management Strategy in partnership with agencies and communities. This includes the building of community resilience by understanding the nature of flooding through flood studies, and planning for floods through emergency response and land use planning.

Floodplain management, in broad terms, can be described as managing:

The legacy problem: This deals with towns/developments that have historically been placed in floodplain areas, and now are exposed to flood hazard. Building resilience is important to minimise flood damage and human suffering.

The future problem: This deals with risk management and land use planning to ensure that new uses, building and works in floodplain areas are compatible with flood risk. In another words, it is about not adding to the legacy problem.

The residual problem: When all flood mitigation plans (and statutory planning outcomes) become overwhelmed, then emergency management response plans are enacted.

During emergency events the CMA have in place arrangements to share staff, intelligence and other resources.

4.5.1 GOULBURN BROKEN REGIONAL FLOODPLAIN MANAGEMENT STRATEGY

The Regional Floodplain Management Strategy was prepared in 2002, and is due for review following the completion of the Victorian Floodplain Strategy. The Regional Floodplain Strategy includes 11 programs such Statutory Planning and the Floodplain Studies programs.

In terms of statutory planning, the Goulburn Broken CMA is a referral body and is required to respond to proposed land use and/or development under the following legislation:

- *Local Government (Planning and Environment Act, 1987, Subdivision Act, 1988, Building Regulations, 2005).*
- *Goulburn Murray Water (Water Act 1989).*
- *DSDBI (Mineral and Resources Act, 1990).*
- *EPA (Environment Protection Act, 1970).*

In addition to statutory referrals, direct enquiries are assessed and responded to by the Goulburn Broken CMA.

Most referrals rely on flood overlay controls within planning schemes. The Goulburn Broken CMA continues to work with Councils to implement flood controls and exemptions into planning scheme.

In terms of flood studies and floodplain management plans, more than two-thirds of the medium to high priority studies have been completed.

4.5.2 STRATEGIC APPROACH

The strategic approach to implement the Floodplain Management Program is through the Goulburn Broken Regional Floodplain Management Strategy, based on a priority and funding opportunities.

Funding initiatives for new studies is largely through the Natural Disaster Resilience Grant Scheme, which matching local funding is required to meet state and federal funding.

4.5.3 COMPETING DEMANDS ON THE ENVIRONMENT

Floodplain Management is also concerned with protecting ecological values of waterways, wetlands and floodplains. To this end, this is carried out through assessment of referrals for land use and development, and for works and waterways program. Furthermore, floodplain implementation plans must have regard to potential adverse impacts to the environment including cultural heritage.

Floodplain Management, in partnership with the Environment Water Reserve Team assists with the hydraulic assessments, including Goulburn River Eildon to the Murray.

4.5.4 STRATEGY REVIEW

The Victorian Floodplain Management Strategy is due to be launched late 2014. This state-wide strategy seeks to take into account a number of recent Parliamentary Inquiries into flooding. It is anticipated that a new Goulburn Broken Regional Floodplain Management Strategy will be developed following the release of the state strategy. Until this time, the Goulburn Broken CMA is working on an Interim Floodplain Management Strategy with Local Government that focuses on study priorities over the next 2-3 years.

4.5.5 KEY FLOODPLAIN ACTIONS

The following Table details Strategic Actions for implementation over the next eight years:

Action	Timeframe	Responsibility
Carry out statutory planning obligations as a referral body, and to provide advice to the general community	2021	GB CMA
Carry out flood modelling and flood mapping	ongoing	GB CMA
Prepare Planning Scheme Amendment for new flood controls including flood mapping	on going	GBCMA
Continue with flood studies, floodplain management plans and assist local government in their implementation	on going	GBCMA, local government
Annually test the Goulburn Broken Flood Response Action Plan	annually	DEPI, local government, SES, GBCMA
Assist VICSES with the Flood Safe Program and provide input into Municipal Flood Emergency Plan		
Work with the Environmental Water Reserve Team to achieve environmental outcomes both within and outside of the catchment.	2015 onwards	GMW, GBCMA, DEPI
Complete review of the Goulburn Broken Floodplain Management Strategy	2015 - 2017	GB CMA

4.6 PUBLIC INFRASTRUCTURE IN OUR WATERWAYS

Public infrastructure is defined as structures, facilities, buildings or areas of land that are used for public or community purposes and are located in, across or adjacent to waterways (DEPI, 2013b). Common examples include weirs, dams, bridges, roads, communication cables, levees, public buildings and sports fields. Public infrastructure is distinguished from private assets (such as private land or buildings).

Waterway processes that can pose risks to public infrastructure include erosion, sedimentation, floods and avulsion.

In addition to maintaining or improving waterway condition, the protection of public infrastructure from waterway processes is an important consideration in waterway management. Protecting public infrastructure is considered important for a number of reasons such as;

- significant public funds have already been invested in the establishment of infrastructure that produce/provide various public goods and services
- public infrastructure enables/increases other waterway values (particularly social and economic)

- By identifying the risks to public infrastructure and managing them before they become severe, the long-term economic costs to the community will be reduced (i.e. replacement costs are often far more expensive than maintenance costs)

The development of the RWSs provides a clear opportunity for waterway managers and stakeholders to determine management arrangements/activities that the waterway manager or other regional agencies should undertake over the eight-year planning cycle.

4.6.1 VICTORIAN GOVERNMENT POLICY: MANAGING PUBLIC INFRASTRUCTURE

- Waterway managers and asset owners will share information to assess risks to public infrastructure from waterway processes.
- Management activities required to manage serious risks to public infrastructure from waterway processes should be negotiated by asset owners, waterway managers and relevant beneficiaries of the public infrastructure.
- Management of serious risks to public infrastructure from waterway processes will be undertaken in accordance with the directions outlined in the Victorian Government response to the ENRC Inquiry into Flood Mitigation Infrastructure in Victoria (where relevant).

4.6.2 PRINCIPLES AND CONSIDERATIONS

- Managing risks to public infrastructure is primarily the responsibility of the asset owner
- The level of protection required for public infrastructure should be decided by asset owners
- Waterway Managers have a number of functions including information provision, works and licensing
- Investment in river health (for example, erosion control, revegetation etc.) will over time reduce risks to public infrastructure

4.6.3 CMA ROLES AND RESPONSIBILITIES: PUBLIC INFRASTRUCTURE

Preparation of RWSs

- Regional waterway management programs will give consideration to waterway processes (for example, floods, erosion and avulsion) and their implications for broad-scale risk for public infrastructure in the catchment.
- There is an expectation that CMAs will align waterway condition improvement works where possible with public asset protection
- When a priority management activity in the regional Waterway Strategy involves works at an existing structure, waterway managers will take a lead role in negotiating an agreement on future management responsibility for the structure.
- CMAs have a role in the regulation (through licensing) of works or activities in a waterway undertaken for the purpose of maintaining, repairing or protecting public infrastructure.

Provision of information and support

- CMAs will provide flood hazard information at a particular scale to enable asset owners to undertake mitigation measures where available
- There is no expectation of CMAs to undertake risk assessments for non CMA owned/managed public infrastructure.
- CMAs will identify risks to public infrastructure (for example, avulsion of rivers, sediment transport impacts etc.) when they are known and where appropriate:

- identify knowledge gaps
- provide information to asset owners
- CMAs often have a detailed knowledge of the location and rates of erosion, flooding, avulsion and other waterway processes that may threaten public infrastructure and this should be shared with asset owners.
- CMAs may be called upon to provide a support role in emergency response situations given their capability. There is no expectation to outline this in RWSs.

4.7 MANAGEMENT OF THREATENED AQUATIC DEPENDENT SPECIES

A number of river reaches and wetlands within the Goulburn Broken catchment are home to national (*Environment Protection and Biodiversity Conservation Act* - EPBC) and state (*Flora and Fauna Guarantee Act* - FFG) listed fauna and Australian rare or threatened (AROT) flora. These flora and fauna are dependent on stream environments in good condition. Healthy waterways not only sustain our native flora and fauna, but also provides for our social, economic and cultural values (GBCMA 2005).The recovery of many threatened species is being addressed under a national Recovery Plan, state Action Statement or protection through the management of threatening processes (see Table 4.3 and Table 4.4). The implementation of programs under the Regional River Health Strategy (2004) also facilitate the protection of key aquatic species (including Macquarie perch, Trout cod, Murray cod, *Barred galaxias* and Spotted tree frog). Sixty rare or threatened faunal species are found within 100 m of a watercourse in the Goulburn Broken Catchment (GBCMA 2005). Twelve of these species are listed under the *EPBC Act*, and of these, six (Macquarie perch, Murray cod, Silver perch, Trout cod, *Barred galaxias* and the Spotted tree-frog) are solely dependent on stream environments.

Of the forty-two significant flora species recorded within 100 m of a watercourse, none are listed under the *EPBC Act*, but five are considered AROTs (Small scurf pea, Narrow goodenia, Alpine bent, Highland bush pea and Ausfield's wattle) (GBCMA 2005). Of these, only Alpine bent could be considered as being dependant on stream environments, and occurs along high priority reaches (GBCMA 2005). The only records for Alpine bent are in the upper Goulburn (Reach 16).

Many threatened species now persist only in small patches of remnant habitat dominated by human influences (Bennett et al.2006) See Chapter 7. Understanding the causes of population declines (past, present and future) is fundamental in the design of effective practical management of threatened species (Norris 2004). In recent years monitoring has focussed on known populations (prescence, numbers and diversity) and the impact of management actions (fishways, habitat) due to funding limitations. Hence there is increased knowledge on pupolations where monitoring has been undertaken.

4.7.1 KNOWLEDGE GAPS

At present, there is limited information on movement patterns and connectivity between populations of large bodied fish species (i.e. Macquarie perch) within the Goulburn Broken Catchment. Understanding these processes may assist management by identifying factors (i.e. in stream barriers or lack of habitat) which maybe restricting movement of individuals within and between water-bodies.

4.7.2 STRATEGIC APPROACH

In an effort to improve the status of freshwater environments and threatened species, the implementation of effective restoration actions and the identification of suitable indicators for measuring the restoration success is vital. For some threatened species, protection and enhancement of habitat may be an appropriate strategy, providing multiple biodiversity benefits. This may also be strategically linked to other on ground actions such as existing works programs. For others, targeted management of a primary threat (e.g. predation or competition from introduced species) may be the most beneficial action, though it in some cases this may not align well with areas of works investment. Private landowners have been suggested as having the most influence on levels of biodiversity (Roberts et al. 2009). As such, it is vital that efforts should be focused on assisting these landowners, particularly those where threatened species persist (either via financial assistance or advice) pertinent to help them manage biodiversity on their properties and undertake better farm management plans.

Table 4.3 - FFG listings and Action Statements for species, Potentially Threatening Processes and Communities - Riverine and Wetland related or Dependent

FFG Action Statements (Aquatic Dependent)
Barred galaxias, *Galaxias olidus* var. *fuscus*. No. 65, Macquarie perch *Macquariaaustralasica* (in prep.), Spotted tree frog, *Litoriaspenceri*. No.112, Trout cod, *Maccullochellamacquariensis*. No. 38
Fauna - Growling Grass-frog, Alpine Tree-frog; Murray Spiny-cray; White-bellied Sea-Eagle, Superb Parrot (RRG forest);
Flora - Menkea crassa (Fat Spectacles), Myriophyllum porcatum, Cullen parvuSmall Scurf-pea, Summer Leek-orchid, Narrow Goodenia, Warby Swamp Gum, Buxton Gum;
Communities: Alpine Bog Community, Creekline Grassy Woodland (Goldfields), Granite Foothills Spring Wetland (North East); Lowland Riverine Fish Community of the Southern Murray-Darling Basin, Montane Swamp Complex, Red Gum No. 1 community,

Long Term Monitoring of Macquarie perch in King Parrot Creek

Yearly fish surveys for Macquarie perch began on the King Parrot Creek in 2006. Since this time we have seen the King Parrot Creek experience years of drought with the creek drying up to mostly pools and large scale fires.

But amazingly the Macquarie perch has survived and even flourished with 2013 surveys showing the strongest population abundance since monitoring started.

Arthur Rylah Institute (ARI) have been committed to undertaking these surveys with support from the Goulburn Broken CMA and are delighted with the results seen over the past 8 years. The 2013 sampling showed successful recruitment of Macquarie perch during the past year. Nine sites are sampled along the creek and sampling techniques included electrofishing with backpack and boat and fyke netting.

The King Parrot Creek community has been vital in this recovery program with many landholders participating in riparian protection works such as stock exclusion fencing, revegetation and weed control. Signs have been placed at key fishing access spots to inform anglers and visitors of the importance of the Macquarie perch population, how to identify them and safe ways to release them if caught.

Photograph by R Ayres: Macquarrie perch Monitoing, King Parrot Creek

Table 4.3 - FFG listings and Action Statements for species, Potentially Threatening Processes and Communities - Riverine and Wetland related or Dependent… (continued)

FFG Threatening processes (Riverine and Wetland related)
Alteration to the natural flow regimes of rivers and streams
Alteration to the natural temperature regimes of rivers and streams(i.e. cold water releases from impoundments)
Removal or degradation of native riparian vegetation along Victorian rivers and streams.
Habitat fragmentation and removal of wood debris from Victorian streams
Increase in sediment input into Victorian rivers and streams due to human induced activities (i.e. land clearing)
Input of toxic substances into Victorian rivers and streams (i.e. agricultural chemicals)
Introduction of exotic fish species and native species translocated into waterbodies outside their natural range within a Victorian river catchment after 1770
Loss of hollow-bearing trees in Victorian native forests
Barriers to fish movement(i.e. weirs)
Introduction of diseases and parasites carried by exotic fish species which can effect native fish
The invasion of native vegetation by environmental weeds
Use of lead shot in cartridges for the hunting of waterfowl
Use of Phytophthora-infected gravel in construction of roads, bridges and reservoirs
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants

Table 4.4 - EPBC Recovery Plans (Aquatic Dependent Species)

Recovery Plan Title	Species Scientific Name	Species Common Name
Spotted Tree Frog Recovery Plan	*Litoriaspenceri*	Spotted tree frog
National Recovery Plan for the Trout cod 2008	*Maccullochella macquariensis*	Trout cod
National Recovery Plan for Murray cod	*Maccullochella peelii peelii*	Murray cod
National recovery plan for Macquarie perch *In-progrees DueOctober/November 2013*	*Macquaria australasica*	Macquarie perch (Macca)
National Recovery Plan for the *Barred galaxias* 2010	Galaxias fuscus	*Barred galaxias*

4.7.3 STRATEGIC PRIORITIES

The aim of the works programs within this Strategy is "to ensure the survival of all threatened aquatic species and maintain current populations in the catchments to maintain current ecosystem function". Further we have the objective to expand the range of species and communities and provide resilience within the watway to ensure the maintenance and improvement of populations of threatened species.

There is the need to prioritise sites containing threatened species based upon their resilience to avoid extinction risk. A multifaceted approach is required for prioritisation which takes into account biodiversity loss, resource limitations and cultural values while meeting overarching legislative obligations. An alternate consideration to prioritising individual species by geographical areas and rank these areas for conservation based on the number of threatened species they contain in addition to the risk posed by these threatening processes (Coates and Atkins 2001). Another approach for prioritising threatened species (and populations) is to examine and rank each threat in order to implement actions to mitigate their impacts. Managing waterways for threatened species must consider other values within the waterway and in adjacent reaches (cultural, social and economic)

4.7.4 STRATEGIC THREATENED AQUATIC SPECIES ACTIONS

The following Table details Strategic Actions for implementation over the next eight years:

Action	Timeframe	Responsibility
Develop and implement strategies to improve the resilience of waterways to enable the re-establishment of robust self-sustaining populations of Macquarie perch and Trout cod in the Goulburn River between Lake Eildon and Barmah. In particular, ensure connectivity with 'satellite populations in Hughes Creek, Sevens Creeks, King Parrot Creek, Hollands Creek and Yea River	2050	DEPI (ARI), GB CMA, community
Identify, prioritise and implement strategies to lesson extinction risk by translocation and stocking of threatened species	2050	DEPI (ARI), FV, GB CMA and community
Undertake research and monitoring to identify and prioritise recovery actions, in line with action statements and recovery plans and adaptive management principles	2050	DEPI (ARI), FV
Ensure connectivity with wetland and off channel habitats along the Goulburn (Catfish and Macquarie perch)	2030	GB CMA
Deliver community initiatives and partnerships to maintain and improve habitat for threatened species and farm production, such as weed control, revegetation and soil and catchment stabilisation	2013 - 2021	Agency stakeholders and community
Develop a plan for listed Aquatic biodiversity values including an objective for threatened species, threatening processes and communities and management approaches to optimise conservation outcomes and ecosystem function/ with resilience being achieved to the desired level.	2021	DEPI (Regional Services), DEPI (ARI), GB CMA

4.8 MANAGEMENT OF RECREATIONAL FISHERIES

Recreational fishing makes an important social and economic contribution to Victorian regional communities. In particular, the Goulburn and Broken River catchment provides some of the most popular native and trout recreational fishing opportunities in Victoria.

The Department of Environment and Primary Industries (Fisheries Victoria) is focused on managing fisheries in a balanced way to ensure ecological sustainability and social and economic outcomes. Fisheries Victoria is also responsible for implementing the State Government's $16 million Recreational Fishing Initiative to improve recreational fishing opportunities by supporting fish habitat recovery works, improving angler access and facilities, fish stocking, protecting fisheries resources and education and compliance activities.

Recreational fishing is highly dependent on the health of the environment including the availability of suitable habitat, water quality and water flow regimes to sustain productive fisheries. Recreational fishers acknowledged this critical dependency in surveys (2009 and 2012) that revealed "repairing where fish live" was the most important recreational fishing investment priority. To improve habitat outcomes on the ground, there is mutual benefit in Fisheries Victoria and recreational fishers working with the Goulburn Broken Catchment Management Authority to identify and collaborate on habitat related projects that lead to better fishing outcomes.

Every year the Victorian Government, through the Recreational Fishing Licence Trust Account, disburses revenue derived from the sale of Recreational Fishing Licences to projects that will improve recreational fishing in Victoria. Since its inception in 2001, the Recreational Fishing Grants Program has funded 521 projects worth more than $21 million throughout Victoria.

4.8.1 KEY RECREATIONAL FISHERIES IN THE GOULBURN BROKEN CATCHMENT

The Goulburn Broken Catchment includes some of the most popular recreational fisheries in Victoria. In 2012, a survey of recreational fishers highlighted that this region features both the most popular recreational fishing lake (Lake Eildon) and river (Goulburn River). Other important fisheries in the GB CMA region include Lake Nagambie, Eildon Pondage, Waranga Basin, Broken River.

A more complete assessment of Victoria's recreational fishing waters can be found in a Guide to Inland Angling Waters of Victoria at: www.dpi.vic.gov.au/fisheries/recreational-fishing/inland-angling-guide.

4.8.2 STRATEGIC PRIORITIES

Fisheries Victoria, key partners and the GB CMA have identified the following key strategic priorities for the management of inland fishing.

1. Maintain key fisheries assets
2. Advocate for fish habitat recovery works
3. Manage fish stocking
4. Encouraging compliance with regulations
5. Improving angler access
6. Develop recreational fishing opportunities

4.8.3 FISHERY MANAGEMENT PRIORITIES

On 11 July 2013, Fisheries Victoria and the Goulburn Broken Catchment Management Authority convened a workshop with key recreational fishing representatives and relevant agencies to identify key fisheries management priorities for the region. The ideas and proposals from this forum were reviewed by Fisheries Victoria against the strategic priorities and are captured as fishery management priorities (Table 1). These priorities were then aligned with the key drivers of the Goulburn Broken CMA Regional Waterway Strategy. The outcomes of this workshop builds on past fishery management planning processes, in particular the 2011 Goulburn Broken Fishery Management Plan.

Fishery management priority actions are shown below.

Broken Creek re-snagging good for recreational fishing

More than 290 large snags (or around 600 cubic metres of woody debris) have been placed along almost 2.5 kilometres of the Broken Creek downstream of Walshes Bridge.

The project, funded through the Victorian Government's Recreational Fishing Licences Grants Scheme, aims to improve recreational fishing in the creek by providing habitat for native fish such as Murray Cod and Golden Perch (or Yellow Belly).

"In-stream habitat mapping was carried out in the Broken Creek between Numurkah and Nathalia by scientists from the Arthur Rylah Institute to identify areas that had a low density of snags. This mapping provided a tremendous picture of the in-stream habitat in the Broken Creek in this section and allowed the project to select areas where re-snagging would have the greatest benefit for native fish populations and anglers.

Snags are the inland equivalent of coastal reefs and provide habitat for native fish and other animals such as tortoises and native water rats. Native fish use them to shelter from fast currents and sunlight and take refuge from predation. Native fish also use snags as feeding and spawning sites, and they are used as nursery areas for juvenile fish.

Monitoring will be carried out to measure the impact of the re-snagging program on native fish populations within the Broken Creek.

Action	Timeframe	Responsibility
Support habitat restoration works where they align with popular recreational fishing river reaches or critical habitat needs for threatened species (refer RFL Survey 2012).	2021	DEPI & GBCMA
Investigate the feasibility of using over-bank environmental flows in the Goulburn and Broken Rivers to enhance native fish recruitment.	2015	DEPI, GBCMA & MBDA
Investigate the feasibility of improving the native fish recreational fishing in the Waranga Basin through habitat enhancement (Refer Goulburn Murray Water On land, On Water Management Plan).	2015	GBCMA, DEPI, VRFish & ATF
Support the re-establishment of woody habitat in the GB CMA region based on the outcomes of DEPI's habitat mapping study recommendations (refer DEPI research report, Arthur Rylah Institute).	2025	DEPI & GBCMA
Focus efforts to establish stocked populations of Trout cod and Macquarie perch in the Goulburn River (between the junction of Hughes Creek and King Parrot Creek).	2014	DEPI, GB CMA & VRFish
Using the Vic Fish Stock consultative process, investigate the case for re-establishing freshwater catfish populations near the junction of the Broken Creek and Goulburn River confluence.	2021	DEPI & Vic Fish Stock
Enhance recreational fishing outcomes in the Goulburn River tailrace fishery by protecting and where needed, re-establishing riparian and in-stream habitat.	2015	GB CMA & DEPI

4.9 MANAGEMENT OF INVASIVE SPECIES

A major threat to the health of the region's waterways are invasive flora and fauna. Management of invasive species is requires a multi-faceted approach, through its planning and implementation over a range of jurisdictions.

An invasive species (DSE 2012) is a species occurring, as a result of human activities, beyond its accepted normal distribution and which threatens valued, environmental, agricultural, cultural or other social values by the damage it causes.

Invasive species includes organisms endemic to a country other than Australia, or translocated native species.

Invasive species that impact waterways may include vertebrates, plants (aquatic and riparian species), invertebrates, algae, pathogens and diseases.

Priority invasive species within the Goulburn Broken catchment include:

Invasive Species	Priority
Vertebrates	European Carp (Cyprinus carpio), Oriental Weather Loach. Misgurnus anguillicaudatus, Redfin (Perca fluviatilis), Trout Brown (Salmo trutta) Trout Rainbow (Oncorhynchus mykiss), Mosquito fish (Gambusia affinis)
Plants	Blackberry (Rubus fruticosus agg. Species) and Willow (Salix spp.) Cabomba (Cabomba caroliniana) and Arrowhead (Sagittaria)

The management of invasive species in waterways (DSE 2012) needs to be holistic and integrated with other waterway health activities, other pest plant and animal control work and fisheries management activities (ie Integrated Catchment Management Framework).

It is clear that in many instances initiatives articulated in the Strategy will be ineffectual without adequate resources being directed towards a resolution of this problem on management of invasive species.

Stocking of both native and introduced fish species takes place in Victoria to improve recreational fishing opportunities. At the State level, the Translocation Evaluation Panel advises Fisheries Victoria on issues related to the translocation of live inland aquatic organisms in accordance with protocols and guidelines. Regionally, stocking is dealt with through a consultative process involving regional input from land and waterway managers and recreational fishers. (See Recreational Fishing Chapter 4.8)

There is currently limited understanding of how waterway restoration activities affect the establishment and spread of invasive species, including how activities designed to eradicate or reduce the impact of one invasive species can affect the establishment and spread of other invasive species. There is some evidence that control of invasive species

can have unintended secondary consequences. It is recommended that a risk based assessment is undertaken, including the development of a conceptual model to aid the identification of intended and unintended consequences).

Management Framework

The Victorian Waterway Strategy sets out policy direction on issues affecting waterway health, including the threat from invasive species. Waterway managers have an important role in undertaking regional actions to contain high risk established invasive species and in protecting high value rivers, estuaries and wetlands from the threats from invasive species. A framework for the management of invasive species in waterways is outlined in Table 4.5 (below).

Action	Timeframe	Responsibility
Assess the risks of inland aquatic invasive species spread through the Victorian water grid	2015-2018	DEPI, Waterway managers, water corporations
Support multi-juristictional process and actions to manage invasive species	2015	DEPI, Waterway managers, water corporations
Support research into the management and control of invasive species	2015 - 2050	DEPI, Waterway managers, water corporations
Identify stream lengths that may require selective removal in very limited sections of a few upper catchment streams to protect valuable species and ecosystems, working in collaboration with relevant stakeholders interest groups.	2013 - 2021	DEPI (Regional Services / ARI), Waterway managers
Encourage and support efforts for control methods and management of Carp within priority waterways (identified) within the region. Highlight level of urgency	2018	DEPI (Policy and ARI), GB CMA
Facilitate “carp muster” days on identified “hot spots” (waterways and wetlands, storages)	2013 - 2021	DEPI (Policy and ARI), FV, GB CMA
Encourage support efforts for enhanced control of invasive plant species. – biological and chenimical control methods	2021	Research Organisations

Table 4.5 - Framework for the management of invasive species in waterways

	Goal	Strategic approach	Lead Victorian policy	Australian/State Government actions	Regional actions
Prevention and preparedness	Prevent new high risk invasive species from establishing in Victoria or spreading to uninvaded Victorian catchments	Species (threat) based	Biosecurity Strategy for Victoria (2009) Invasive Plants and Animals Policy Framework (2010)	– Undertake pre-border and border security – Undertake risk assessments – Develop and implement reporting framework	Support national and state-wide programs aimed at preventing the introduction and establishment of new high risk invasive species in waterways – Support informed community effort in invasive species management in waterways – Surveillance monitoring in waterways
Eradication	Eradicate high risk invasive species in the early stage of establishment	Species (threat) based	Biosecurity Strategy for Victoria (2009) Invasive Plants and Animals Policy Framework (2010)	– Clearly identify agency roles and responsibilities for participating in emergency eradication responses – Develop and implement emergency preparedness and rapid response plans – Co-ordinate eradication activities at a national/state scales	– Eradicate all newly establishing populations of Regionally Prohibited Weeds and other identified high risk invasive species in waterways – Support national and state-wide programs aimed at eradicating high risk invasive species in waterways – Support informed community effort in invasive species management in waterways – Surveillance monitoring in waterways
Containment	Contain high risk invasive species	Species (threat) based	Victorian Waterway Management Strategy	Lead agency engages with waterway managers, water corporations and communities on containment programs	– Prevent identified high risk established invasive species in waterways from spreading outside core infestation boundaries – Eradicate outlier infestations – Protect assets within core infestation – Support informed community effort in invasive species management in waterways – Surveillance monitoring in waterways
Asset based protection	Reduce the impact of established invasive species	Asset (value) based and Species (threat) based	Victorian Waterway Management Strategy	Lead agency engages with waterway managers, water corporations and communities on community education, asset management planning, implementation, monitoring and reporting	– Assess the threat of invasive species on the values of waterways – Undertake appropriate actions to reduce the impacts of invasive species on the values of priority waterways – Support informed community effort in invasive species management in waterways – Surveillance monitoring in waterways

4.10 MANAGEMENT OF THE RIVER CHANNEL

Management of the waterway channel (DEPI, 2013b) needs to be based on an understanding of the geomorphological and hydrological processes that exist within our catchment.

The focus of early waterway management, was directed toward improving channel efficiency, navigation and prevent nuisance flooding by opening the channel (removal of in stream obstructions) channel straightening and realignment. Fortunately most of these actions are not currently practiced.

Where catchments and water regimes are largely unaltered erosion and sedimentation processes are comparatively balanced, the focus of management is on maintaining natural processes, managing invasive species and managing waterway related bushfire risks, flood risks, drought impacts.

Where natural river channel processes have been accelerated or changed by land use in the catchment, outdated river management activities or by changes to the water regimes, the channel may become unstable and affect channel form, resulting in lower resistance to flood damage, increased erosion and alterations to overbank flow.

Improving channel stability and the condition of river channels in degraded areas requires a long-term approach that focuses on riparian management programs (See Chapter 4.1) and Integrated Catchment Management (See Chapter 4.11.2).

Successful management of the river channel requires an approach that:

- clearly identifies the uses (values) of the waterway
- clearly identifies roles and responsibilities;
- promotes partnerships with land and water managers, local government and the community
- sets out the management approach; and
- defines best practice standards for maintenance and improvement works.

Waterways will be managed to achieve appropriate rates of erosion, sedimentation and avulsion over the long-term, consistent with natural processes.

Management of the river channel will focus on maintaining and improving the bed, banks, in stream habitat, riparian land and integrated catchment management to improve resistance and resilience to the adverse impacts of waterway processes on river channel condition and public infrastructure.

Options for changing river operations to improve the water regime in priority regulated rivers will be investigated as part of the regional Waterway Strategies (See Chapter4.3)

4.10.1 WORKS ON WATERWAYS

Works and activities that are undertaken within the river channel have the potential to degrade the physical form of waterways and affect the environmental values of the channel and associated habitats (crossings, access points, bridges). It is important that controls, standards and guidelines are in place to manage the risks posed by such works and activities.

Works and activities in waterways include construction of bridges and access crossings, bed and bank erosion control works, stormwater drainage outlets, removal of invasive in stream vegetation, installation of pipelines and stream realignment.

Where works and activities in waterways are not undertaken in accordance with best-practice standards, they may pose a risk to waterway values, landholders or public infrastructure. In addition to the regulatory provisions under the *Water Act 1989* (see Chapter 11.2.1) the Technical Guidelines for Waterway Management and the Guidelines for Assessment of Applications for Permits and Licences for Works on Waterways provide guidance to waterway managers on best management practice for engineering works in waterways.

Action	Timeframe	Responsibility
Provide adequate resources to enable the management of works on waterways to prevent threats to the ecological systems and manmade assets.	2013 - 2021	GB CMA, DEPI (Waterway Policy)

4.10.2 PREVENTING DEGRADATION OF THE RIVER CHANNEL

Experience in recent floods indicates that to minimise the risk of flood damage to works and activities, they need to be designed to take account of the river processes of erosion and sedimentation and need to be regularly maintained.

Waterway managers will work with proponents of works and activities in waterways to:

- *ensure compliance with regulatory requirements*
- *promote best-practice standards of design to:*
  - *maintain or improve the environmental resilience of the site and surrounds*
  - *avoid causing instability or adverse site impacts or increased flood impacts*
  - *minimise the risk of damage to the works from future flooding and waterway processes*
    reduce the likelihood of affecting other parties and infrastructure
    encourage adequate operation and maintenance of works into the future

Large wood and native in stream vegetation are important habitat in rivers. They provide shelter, food sources and breeding sites for a variety of in stream animals, including threatened fish species, as well as contributing to biological processes within the river channel.

Large woody habitat is an important structural component of rivers, assisting in the formation of features such as scour pools and channel bars and in stabilising the river channel. In large lowland rivers, large woody habitat may be the only stable substrate and an important in stream source of nutrients.

In stream diversity has been heavily modified since European settlement. Extensive removal of large woody habitat and in stream vegetation clearing occurred in Victoria (Department of Environment and Primary Industries, 2013a) from the late 1800s to late 1990s with a view of increasing conveyance of flood water. However, extensive research has shown that large woody habitat has negligible impact on channel capacity and removal does little to improve flood conveyance. In addition, in stream vegetation and large woody habitat have been found to reduce bed erosion.

The removal of large woody habitat and in stream vegetation is a threatening process, and leads to increases in flow velocity, bed degradation, channel enlargement and loss of important in stream habitat.

There may be some isolated instances where the removal of large woody habitat or in stream vegetation is warranted to maintain the social or economic values of a waterway, reduce an immediate threat to public infrastructure or reduce public risk. In such cases, waterway managers will need to balance the habitat benefits against the level of risk.
The Victorian Investment Framework funded project entitled “In stream Woody Habitat Assessment” (IWH) aimed to help the Government and the regional waterway managers prioritise the protection and rehabilitation of in stream woody habitat in rivers (Department of Environment and Primary Industries, 2013a). Researchers from the Department of Environment and Primary Industries’ (DEPI) Arthur Rylah Institute (ARI) have been working with Fisheries Victoria, Catchment Management Authorities, the University of Melbourne and Melbourne Water to investigate past and present IWH densities in Victorian rivers.

The project mapped IWH densities in approximately 38,000 river reaches across Victoria. Field assessments of natural IWH densities were undertaken in “pristine” river reaches using hand-held GPS and underwater sonar. The results for the Goulburn Broken regions shows that many of our waterways are depleted in woody habitat. These results will guide the strategic implementation of habitat activities in the region.

Priority waterways, on the basis of the IWH project and the AVIRA risk assessment process, for the improvement of in stream diversity include: Goulburn River (reaches 1 – 8) Goulburn River (reaches 9 – 14), Broken Creek (reaches 21 – 23), Broken River (reaches 1 – 4) and lower floodplain of Goulburn River tributaries (Yea River, King Parrot Creek and Acheron River).

Large woody habitat or native in stream vegetation will not be removed from river channels unless it is demonstrated to pose a serious risk to public safety or public infrastructure. Realignment or anchoring of large woody habitat will be undertaken where feasible, rather than removal.
Where programs to reinstate large woody habitat or in stream vegetation are planned to improve the condition of the river channel, the benefits and risks will be assessed in consultation with the community.

Action	Timeframe	Responsibility
Further refine priority reaches and mapping for maintenance and improvement to in stream habitat across the region	2013 - 2018	GB CMA, DEP (ARI) FV
Install IWH within priority river reaches (see Chapter 7)	2013 - 2021	GB CMA, DEP (ARI) FV

4.11 MANAGEMENT OF EXTREME EVENTS

Over the last ten years the Goulburn Broken Catchment, has experienced several extreme events. Extensive bushfires occurred in summer 2006/2007 and in 2009, unseasonal summer flooding occurred in many sub-catchments in 2010, 2011 and 2012 and we experienced drought conditions over a seven year period.

The purpose of this Chapter is to clarify the management framework to reduce, respond to and recover from the impacts of extreme and catastrophic events and waterway incidents. Table 4.6 highlights the impacts of extreme events and waterway incidents

Table 4.6 - Impacts of extreme events and waterway incidents;

Event	Impacts
Floods	• accelerated rates of river channel erosion • channel avulsions (the abandonment of the main river channel in favour of a new course), • channel widening • sedimentation, infilling of deep pools and shallow channels, and impacts on wetlands • loss of large wood. • damage to waterway and environmental activities (fences, riparian vegetation and erosion control activities) • spread of invasive species. • damage and threats to infrastructure (erosion and debris) • wastes from sewage treatment facilities may enter waterways; and • loss of livestock
Fire	• increase in runoff may result in flooding • increased sediments and nutrients loading into waterways and wetlands • nutrient increase may result in algal blooms • iIncreased erosion may result in sediment transport. • reduced oxygen levels and cause fish deaths • disrupt the natural breeding cycles of aquatic native • destroy native animal habitat, impair biological functions • increased risk of weed invasion. • loss of riparian vegetation through bushfire can reduce shading, increasing the water temperature of rivers or wetlands. • increase the risk of erosion in the next flood. • contamination of water storages and potable water supplies with ash, sediment and fire retardants.

	• damage public infrastructure and waterway assets (fences, revegetation and erosion control works) • livestock deaths
Drought	• reduce pool connectivity, native fish movement • loss of immobile aquatic species • reduced in stream water quality • change of riparian vegetation structure
Waterway Incidents – Low DO / blackwater and algal blooms	• reduced in stream water quality • fish deaths • damage to aquatic flora and fauna
Chemical Spills	• fish deaths • damage to aquatic flora and fauna • water unfit for many uses (human, stock, etc)

4.11.1 EMERGENCY MANAGEMENT ARRANGEMENTS

Floods and bushfires may be classed as emergencies (DSE, 2012). Key legislation and policies for emergency management in Victoria include the *Emergency Management Act 1986*, underpinned by the *Emergency Management Manual Victoria,* which identifies high level roles and responsibilities for agencies involved in emergency management. The Manual also contains the *State Emergency Response Plan, State Relief and Recovery Plan* and outlines structures for emergency planning at State and regional levels.

Emergency management	Emergency management consists of three types of activities. Prevention, mitigation and preparedness activities eliminate or reduce hazard impacts, increase community or environmental resilience, establish planning arrangements, and increase community education and awareness. Response activities take place during and immediately after an emergency event. Recovery activities involve reconstruction of physical infrastructure and restoration of affected environments and communities.

4.11.2 PREVENTION MITIGATION AND PREPAREDNESS

The Goulburn Broken region has established a Regional Water and Contingency Planning Group which assesses risks and responds to waterway incidents. This group developed and partners have signed the 'Partnership Agreement for Preparedness and Response to Waterway Incidents in the Goulburn Broken Catchment'

Members of the above Group include, but is not limited to: Department of Environment and Primary Industries (formally Sustainability and Environment), the Environment Protection Authority Victoria, the Goulburn Broken Catchment Management Authority, Goulburn-Murray Water, Goulburn Valley Region Water Authority, North East Region Water Authority; Representatives from local government, Waterwatch, the Regional Water Monitoring Partnership and the Department of Human Services support the Agreement. This is considered a critical frontline service by partners.

ACTION: That the Regional Water and Contingency Planning Group continue to operate to plan and respond to waterway incidents	
Responsibility: Regional Water Quality Partners	**Timeframe** on-going

Waterway managers (DEPI, 2013b) need to plan and prepare for the impacts of floods and bushfires on waterways and public infrastructure. Activities identified that may reduce the risk to waterways and infrastructure include: undertaking erosion control works to prevent erosion at sites of high energy flows occur, removal of debris from infrastructure built up during a previous flood.

Planning for the impacts of fire is problematic. The scale and impacts of fire are unpredictable and limits the ability to protect waterways and public infrastructure.

ACTION: Provide Input to Fire Protection Plans, Fire Operation Plans and Municipal Emergency Management Plans to ensure that high value waterways are maintained	
Responsibility: Catchment Management Authority	**Timeframe** on-going

ACTION: (from Policy 15.4 VWMS) Adopt a risk-based approach to address the impacts of floods and bushfires on waterways and associated public infrastructure. **Develop a program of on-ground works to reduce the impacts on waterways and public infrastructure from flood and bushfire. The program will be included in the regional Waterway Strategies and will constitute the disaster mitigation strategy for flood and bushfires in relation to waterways in the catchment management region.**			
Responsibility:	Waterway managers (Catchment Management Authorities)	**Timeframe**	2018

4.11.3 RESPONSE ACTIVITIES

Following extreme flood or bushfire events urgent works may be required to address immediate risks to waterway health and infrastructure.

Activities required include: clearing of flood debris in waterways to maintain public infrastructure; stabilising waterways affected by erosion threatening public infrastructure; addressing threats to water quality or relocating threatened species that cannot survive in waterway habitats affected by bushfire.

In this period of activity it may also be necessary to support water quality and flood level data capture.

ACTION: Following extreme events a regional Planning Group will be establish to respond to emergency works and monitoring			
Responsibility:	Waterway managers (Catchment Management Authorities) Frontline sevrvice	**Timeframe**	2018
ACTION: For natural flood and bushfire disasters, waterway managers will prepare and submit to the Department of Treasury and Finance, applications for funding in accordance with the National Natural Disaster Relief and Recovery Arrangements Determination 2011.			
Responsibility:	Waterway managers (Catchment Management Authorities) Frontline service	**Timeframe**	2013-2021

4.11.4 DISASTER RECOVERY AND REHABILITATION

Immediately following an event it is necessary to undertake an evaluation of any necessary emergency stabilisation, rehabilitation and recovery works. This will be generally undertaken in partnership between all regional government agencies.

This assessment will clarify the nature and extent of the event/s, recommended strategies to reinstate the damage caused to and an estimate of cost implications. Waterway management program priorities may need to be adjusted to enable priority waterway management actions to be undertaken.

ACTION: Following extreme events a review of waterway and wetland priorities will be undertaken			
Responsibility:	Waterway managers (Catchment Management Authorities) Statement of Obligations / *Water Act (1989)*	**Timeframe**	as required (2021)

4.12 INFLUENCE OF THE SURROUNDING CATCHMENT

The condition of neighbouring catchments and land is a key driver of waterway condition (DSE, 2013). Therefor management of waterway and wetland condition must consider and integrate with the management of the surrounding catchment. Also important is to integrate with related Catchment Management and regional programs.

Some activities occurring on the land surrounding or adjacent to waterways have a significant effect on water quality, bed and bank stability, floodplain connectivity, aquatic biodiversity and riparian vegetation (see Figure 4.7).

Management of the catchment must consider a range of scales, from landscape, to sub-catchment through to property.

These linkages are currently recognised by the integrated catchment management framework operating within the Goulburn Broken Region. While funding may often be silo based every effort is made to integrate projects at a local scale, and to achieve multiple benefits from investment. With the proposition of RCS based funding, silos will be removed and lead to more effective integrated projects and simplify community participation.

Major management activities that affect river health are shown in Table 4.7 (DSE, 2002).

Table 4.7- Major land management activities that affect river health

Activity	Impact on River Condition
Catchment clearing including urbanisation	Changed stream flows - peakier, less base flow; can increase in stream erosion and sedimentation Construction of dams and weirs have altered the natural hydrograph Increased catchment erosion hence sedimentation of streambed, smothering biota Poor quality runoff causing deterioration in in stream habitat Industrial and urban pollutants and waste have contributed to loss of water quality Increased salinity levels Loss of wetland habitat Widening of channels Shallowing of channels Filling in of deep pools with sand and sediment Invasion of exotic biota. The riparian zone and wetlands have been invaded by aggressive exotic domestic and agricultural weeds The removal of the deep rooted vegetation has led to a rising in the water table, mobilising the salt stored in the soil, contributing to a reduction in water quality
Inappropriate land management	Increased input of contaminants (containing high concentrations of nutrients, principally Phosphorous (P) and Nitrogen (N)), depending on the land use Rabbit infestation which can damage riparian vegetation, increase erosion and hence increase sediment input Loss of wetland habitat Increased run-off has caused extensive rill, sheet and gully erosion
Disposal of poor quality effluents	Reduced habitat quality from poor water quality Changed species composition Algal blooms
Degradation of the frontage / riparian zone	Changed vegetation structure and species composition, especially understorey Reduced regeneration Weed invasion Bank instability hence erosion and sediment deposition in waterways Reduced/no input of organic matter and snags to rivers Reduced quality of bank habitat for aquatic animals Bank erosion and sedimentation leading to changed channel shape Increased turbidity Increased water temperature Changes in dissolved oxygen levels in the water Loss of woody debris Channel incision Compaction of the soil by hoofed feet has led to a decline in the soil structure and has contributed to the increase in run-off, further erosion, nutrification and continued river degradation Decreased interception of rainwater by riparian vegetation due to its removal

4.12.1 STRATEGIC PRIORITIES

The following key strategic priorities for the management of adjacent lands for the protection of waterways and wetlands for the life of this Strategy.

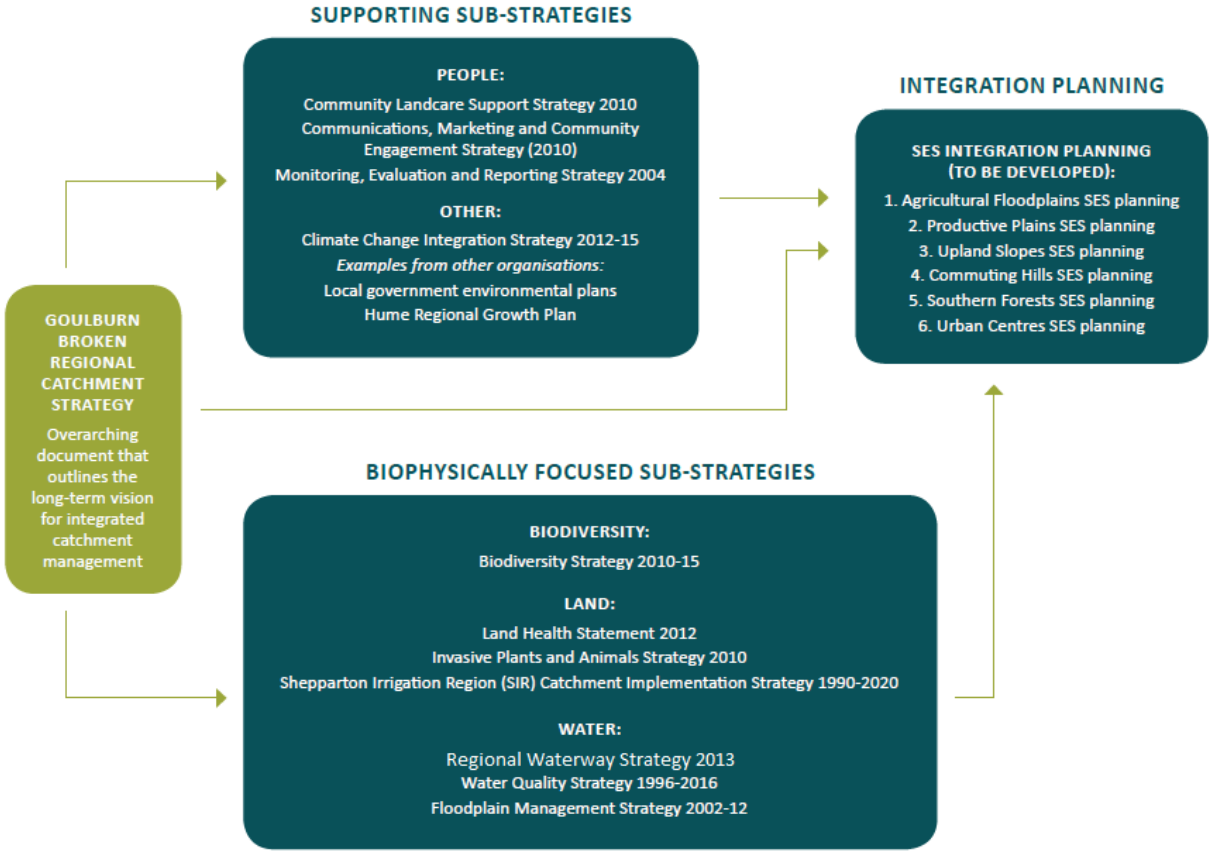
1. Integrated Catchment Management (See Chapter 4.12.2)
2. Riparian Management (See Chapter 4.1)
3. Floodplain Management (See Chapter 4.5)
4. Protection of Water Quality (See Chapter 4.2)
5. Planning (Property, Local and Catchment Scale, See Chapter 4.12.3)
6. Water Savings (See Chapter 4.12.4)
7. Integrated Water Cycle Management (See Chapter 4.12.5)

4.12.2 INTEGRATED CATCHMENT MANAGEMENT

Integrated catchment management is the co-ordinated involvement of agencies, stakeholders and the catchment community in policy making, planning, and management to protect the resilience of the catchment. Integrated catchment management recognises the intrinsic linkages between land use in catchments and subsequent impacts on land, water and biodiversity and seeks a holistic approach to their management.

The Waterway Program will be integrated with other key regional programs based on the seven social ecological systems or landscapes: Agricultural Floodplains; Productive Plans; Commuting Hills; Upland Slopes; Southern Forests; Urban and Catchment Wide. The planning Framework for the Catchment is shown in Figure 4.3 below.

Figure 4.3 – Integrated Catchment Planning (Catchment to SES) (source Goulburn Broken Regional Catchment Strategy)



4.12.3 PLANNING

Planning, Catchment and Regional Scale

While much can be undertaken to improve or enhance the condition of our waterways and wetlands, management must consider the management in the broadest context - entire catchment.

The **Department of Transport, Planning and Local Infrastructure** (formally Department of Planning and Community Development) is responsible for land-use planning and environmental assessment in Victoria. This includes managing the regulatory framework and providing advice on planning policy, strategic planning and urban design.

Under Victoria's planning system local councils and the Victorian government develop planning schemes to control land use and development, and to ensure the protection and conservation of land.

Sub-regional Planning will be undertaken through the development of SES Integration Plans, which are to be promoted by the Catchment Management Authority.

Planning at a landowner scale - Whole Farm Planning

Whole Farm Planning (WFP) is a process of planning, property design and management based on natural resources and economic factors.

WFP focuses on all of the farm assets (physical and nonphysical) over a long period of time (perhaps several generations). WFP covers the knowledge and skills to be able to plan a sub-division, irrigation layouts, assess land capability and potential of a farm.

Key components of a Whole Farm Plan includes: Land classing, Soils, Farm water supply, Biodiversity, Pest plants and animals, Pastures, Succession planning, Waterways and Wetland Assets, Grazing management, Drought management, Prioritising works, Identifying threats and assets, cropping techniques, tillage and development of realistic action plans.

4.12.4 WATER SAVINGS

The Farm Water Program began in 2009 as a result of a consortium of Northern Victorian agencies and industry organisations (lead by the Goulburn Broken Catchment Management Authority) developing a funding proposal to help irrigators achieve farm water savings through improved farm irrigation systems.

The water savings are shared between farmers and the environment, with at least half the water savings transferred to the Victorian or (mainly) Commonwealth environmental water holder. This means more water is also available to protect and restore river health, which in turn builds the resilience of the Catchment's waterways and secures supply for domestic, industrial and agricultural use.

More efficient water delivery systems (on and off farm) reduce groundwater accessions and nutrient run-off and help address re-emerging salinity and water table issues in the Catchment's Agricultural Floodplains.

Types of farm works funded include improving border-check irrigation by lasering, re-use systems, outlet automation, appropriate flows, farm channel reconnections, installing pipes and risers; installing scheduling equipment, including soil, plant or weather monitoring systems to calculate water needs; and conversion of border check irrigation to a pressurised system including centre pivot, linear move, fixed sprinkler or surface and sub-surface drip.

There are several features of the Farm Water Program that ensure best practice (and reduce risk). These are:

- Works are based on robust Whole Farm Plans (these have been undertaken across the region for more than 20 years).
- Water savings are based on a water-savings calculator, developed from research over the past 20 years.
- Costings are based on quoted costs and checked against regional industry standards.
- The Farm Water Program includes all the main partners in water management in Northern Victoria - Northern Victoria Irrigators, Dairy Australia, North Central CMA, North East CMA, Goulburn-Murray Water, DEPI and Goulburn Broken CMA (lead partner)
- There are synergies with the irrigation modernisation program and land and water management plans.

Additionally, the program has significant flow-on effects for local economies across the Goulburn Murray Water Services area, creating jobs, boosting industry confidence and maintaining social vigour.

To date, more than $200 million has been secured from a range of sources: the Australian Government's - On Farm Irrigation Efficiency Program ($46 million)); the former Northern Victorian Irrigation Renewal Project ($16 million); the Victorian On Farm State Priority Project ($45 million) and the Victorian Farm Modernisation Project (up to $100 million delivered in three tranches).

4.12.5 INTEGRATED WATER CYCLE MANAGEMENT (IWCM)

As the region's urban centres develop and Melbourne's Growth Corridor extends northwards into the region, coupled with the variability of our climate, a new approach is required for the management of our precious water resources. Increased growth places additional pressures on drinking water supplies, the quality and quantity of storm water run-off, drainage networks, and wastewater management facilities, all potentially impacting on waterway health, the environment and the liveability of our communities.

The Living Victoria systems analysis approach has been used to inform the development and publication of a new water cycle planning framework for metropolitan Melbourne, *Melbourne's Water Future* based on Integrated Water Cycle

Management principles. In future similar spatial analysis and systems modelling in regional Victoria is expected to provide a template for Integrated Water Cycle Management in the regions.

The development of these regional frameworks will be coordinated by the Office of Living Victoria. The Office of Living Victoria proposes to work with key regional stakeholders, water authorities, local government, catchment management authorities, regulators, the development industry, and all other identified stakeholders to improve the water efficiency and liveability of existing and new communities.

In new urban developments and the urban infill/redevelopment of existing towns, a holistic whole of water cycle planning and management approach can ensure that there is sufficient fit for purposes water for the community and the environment.
Benefits of the program include:

- Water quality (Refer to Water Quality Chapter 4.2)
- Environmental Flows
- A community engaged in whole of water cycle management
- Suburbs – old and new- designed with water in mind
- Sensible use of water in our homes, gardens, community facilities and businesses
- Resilient water systems
- Improved natural waterways
- Reduced inefficiency and waste

Some elements identified in the development of *Melbourne's Water Future* which may have applicability in rural areas include but are not limited to: the use of rainwater tanks on lots to mitigate storm water run-off, the use of rain water tanks to provide water supplies for non-potable uses such as toilet flushing, washing machines and gardens, better utilisation of stormwater through rain gardens, swale drains and nature strips, using existing and constructed wetlands to act as bio-filters, improving water quality before re-use or return to stream, commercial buildings reuse of water from their roofs and paved areas, sports clubs redirecting stormwater to their grounds, consideration of purple pipes (recycled water) for substitution for non- potable and industrial uses.

Action: Facilitate adoption and implementation of IWCM principles in the region. Develop and implement IWCM projects	
Responsibility: CMA, Water Corporations and Municipalities	Timeframe: 2015 - 2019

4.12.6 ENGAGEMENT AND PARTICIPATION OF OUR COMMUNITY

The largest group of stakeholders that can effect change to bring about improvements to our catchments and waterways are the private landowners (including farmers, landmanagers, absentee landholders)..

Through the implementation of best practice for property management our community gains a more productive landscape and gain a healthier environment. The implementation often comes following financial support through incentives and grants. This follows the decision that there is an appropriate level of support by the landowner from the relevalt authority..

It is important that the landowners not only recognize their responsibilities but also recognize that improvements to the bottom line of managing a productive property can be achieved through adopting best management practices.

However, engagement of the community needs to be inclusive and involve (but not limited to): anglers, sporting clubs, community groups and clubs, field naturalists, sporting shooters, etc.

4.12.7 STRATEGIC ACTIONS

The following Table details Strategic Actions for implementation over the next eight years:

Action: Promote best practice: Multi-benefit - gaining a more productive landscape and a healthier environment within the Communications Strategy (see Chapter 8)	
Responsibility: DEPI, GB CMA and Landcare	Timeframe: 2015-2021

Action: Include waterways and wetlands as key features (in all levels of planning) within Local Planning - including Whole Farm Plans	
Responsibility: DEPI, GB CMA, Landowners and Landcare	Timeframe: 2015-2021

Action: Provide protection for key waterways and wetlands through Land Use Planning	
Responsibility: Local Government, DEPI, GB CMA	Timeframe: 2015-2021

4.13 PLANNING FOR CLIMATE CHANGE

This Paper details how climate change is to be considered in the strategy (related to waterway and wetland management)

4.13.1 WHAT IS CLIMATE CHANGE

It is generally accepted (Dyer et al, 2012) that the climate is changing and it is predicted that major changes to runoff, stream flow and water quality will result. These changes are likely to leave freshwater ecosystems exposed to increased risk.

The Earth's climate has changed over the last century (DSE, 2012) where there have been evidence of increases in average temperatures, concluding that most of the warming observed in the last 50 years is due to human activities.

Climate change has the potential to adversely affect our environment, our communities and our economy. It is widely considered that as a community we need to take action now to reduce our greenhouse gas emissions and prepare for the impacts of climate change.

Climate change will alter global and local climates. In Victoria, this means a warmer and drier future, with an increasing likelihood of more extreme events such as heatwaves, bushfires and storm surges.

4.13.2 PREDICTIONS

The Goulburn Broken Catchment Management Authority Climate Change Position Paper (Feehan, 2007) provides a detailed background on climate change in the Goulburn Broken catchment and the implications for the region's natural assets. The scenarios and assessment of impacts are shown in the figure 4.8 and 4.9 below:

Table 4.8 – Climate change Scenarios for 2030 and 2070 for North east Region

Season	2030	2070
Spring	Warmer by 0.3 to 1.6°C Rainfall decrease likely (+3 to – 15%)	Warmer by 0.8 to 5.0°C Rainfall decreases likely (+10 to -40%)
Summer	Warmer by 0.3 to 2.0 °C Rainfall change uncertain (±15%)	Warmer by 0.8 to 6.0°C Rainfall change uncertain (±40%)
Autumn	Warmer by 0.3 to 1.6°C Rainfall change uncertain (±10%)	Warmer by 0.8 to 5.0°C Rainfall change uncertain (±25%)
Winter	Warmer by 0.2 to 1.4°C Rainfall decrease likely (+3 to -10%)	Warmer by 0.7 to 4.3°C Rainfall decrease likely (+10 to -25%)

CSIRO projections for north-eastern Victoria were based on the results of 12 climate models that had good simulations of observed average patterns of temperature, rainfall and atmospheric pressure over south-eastern Australia (Feehan, 2007). Warmer and drier conditions are likely, with more heatwaves, fires, droughts and rain storms, fewer frosts and less snow.

Predicted climate changes likely for north-eastern Victoria.

Table 4.9 - Climate variables and likely changes due to climate change by 2030 and 2070

Variable	Changes
Temperature	Annual warming of 0.3 to 1.6°C by 2030 and 0.8 to 5.0°C by 2070 Daytime maximum temperatures and night-time minimum temperatures are likely to rise at a similar rate Warming is likely to be greater in spring and summer 10-60% increase in the number of hot summer days (35°C) by 2030 and a 20-300% increase by 2070 on the plains. Rate of increase will be greater in the mountains 0-50% reduction in the number of frost days by 2030 and a 50-100% decrease by 2070
Rainfall	Annual rainfall decrease are likely (changes of +3% to -10% by 2030 and +10 to -25% by 2070) Extreme daily rainfall events are likely to become more intense.
Snow	Area with at least 1 day snow cover per year likely to be reduced 10-40% by 2030 with 22-85% by 2050 Area with at least 60 days snow cover shrinks 18-60% by 2020 and 38-96% by 2050 At Mt Hotham, peak snow depth declines 10-50% by 2020 and 25-95% by 2050
Drought	Droughts are likely to become longer and more frequent, particularly in winter-spring Rainfall deficiencies that currently occur once every 5 winter springs may occur once every 3-5 years by 2030 and once every 2-3 years by 2070 Due to hotter conditions droughts are also more likely to become more intense
Fire	10-40% increase in the frequency of days with extreme fire-weather risk by 2020, and 20-120% increase by 2050 4-25% increase in the frequency of days with very high and extreme fire-weather risk by 2020, and 15-70% increase by 2050
The climate of Wangaratta	A 1°C warming and a 5-10% rainfall decrease (a moderate scenario for 2030) would make the climate of Wangaratta more like the current climate of Corowa.

There are substantial implications of these scenarios for the catchment's water resources - predicted that major changes to runoff, stream flow and water quality.

4.13.3 IMPACTS OF CLIMATE CHANGE

Victoria's communities, industries and environment are likely to be impacted on by climate change. The difficulty is, and will remain for some time uncertainty over the scale and timing of climate change impacts. However, a high level of variability is certain.

With the additional effects of climate change, human influences will become even more severe as ecosystems are progressively exposed to greater risk.

Preliminary research (DSE, 2012) has highlighted that climate change is already affecting Victoria's plants and animals. Many of Victoria's ecosystems have a limited ability to adapt to climate change (DSE, 2012). Those restricted to small geographic areas, or unable to migrate fast enough to keep pace with shifting climatic zones, will be particularly vulnerable. However, some ecosystems and species will be advantaged or unaffected by climate change.

Water resources and management Projected drying trends over much of the state Victoria's will render water resources increasingly vulnerable (DSE, 2012). At the same time, population increases will increase demand for water.

These impacts could, however, be offset if we get more rain in summer. However, intense storm events are likely to impact on water quantity – turbidity, sedimentation and blackwater. To understand the possible impacts an initial planning process aimed to identify the current threats and propose if climate change will alter the level of threat to assets and resilience of the region. The outcome of this work is shown in Table 4.10, where each threat is considered and the suggested impact of climate change (ie increased level of threat, decreased level of threat, no change)

Table 4.10 – Climate Change, influence on threat levels, Management Strategies (Adaptation).

Prediction (Goulburn Broken region)
A. Annual warming of 0.3 to 1.6°C by 2030 and 0.8 to 5.0°C by 2070 B. Daytime maximum temperatures and night time minimum temperatures are likely to rise at a similar rate C. Warming is likely to be greater in spring and summer D. 10-60% increase in the number of hot summer days (35°C) by 2030 and a 20-300% increase by 2070 on the plains. Rate of increase will be greater in the mountains E. 0-50% reduction in the number of frost days by 2030 and a 50-100% decrease by 2070 F. Annual rainfall decrease are likely (changes of +3% to -10% by 2030 and +10 to -25% by 2070) G. Extreme daily rainfall events are likely to become more intense. H. Area with at least 1 day snow cover per year likely to be reduced 10-40% by 2030 with 22-85% by 2050 I. Area with at least 60 days snow cover shrinks 18-60% by 2020 and 38-96% by 2050 J. At Mt Hotham, peak snow depth declines 10-50% by 2020 and 25-95% by 2050 K. Droughts are likely to become longer and more frequent, particularly in winter-spring

Threat (AVIRA)	Threat	Association to prediction	Threat (under Climate Change prediction)	Strategy
ALTERED WATER REGIMES	Increase in Low Flow Magnitude	F,K,L,M	increase	Environmental Flows
	Reduction in High Flow Magnitude	F,K,L,M	increase	Environmental Flows, Modify Barriers, Floodplain Connectivity
	Increase in Proportion of Zero Flow	F,K,L,M	increase	Environmental Flows
	Change in Monthly Stream flow Variability	F,,K,L,M	increase	Environmental Flows, Fish Migration
	Altered Stream flow Seasonality	F,K,L,M	increase	Environmental Flows, Fish Migration
ALTERED PHYSICAL FORM	Bank Instability	F,K,L,M,N,G	increase	Riparian and Frontage Management, Erosion Control
	Bed Instability (Degradation)	F,K,L,M,N,G	increase	Riparian and Frontage Management, Erosion Control
POOR WATER QUALITY	Degraded Water Quality	N,OM,K,L,F	Slight increase	Water Quality Improvement / Protection
	Thermal Water Pollution	N	same	Riparian and Frontage Management, Erosion Control, Catchment Management (point and diffuse source)
	Disturbance of Acid Sulphate Soils		same	Riparian and Frontage Management, Catchment Management
DEGRADED HABITATS	Degraded Riparian Vegetation	A,D,F,K,L,M,F	increase	Riparian and Frontage Management
	Loss of In stream Habitat	F,K,L,M,G	same	Riparian and Frontage Management, Habitat Management (in stream)
	Sedimentation	F,K,L,M	Slight increase	Riparian and Frontage Management, Erosion Control, Catchment Management (point and diffuse source)
	Livestock Access		same	Stock Exclusion/management (Riparian and Frontage Management)
POWER	Hydro-Electricity	K	same	
INVASIVE FLORA AND FAUNA	Invasive Flora (Riparian)	F,K,L,M	increase	Stock Exclusion/management (Riparian and Frontage Management), Water Quality protection,
	Invasive Flora (Aquatic)	F,K,L,M	increase	
	Invasive Fauna (Terrestrial)	F,K,L,M	increase	
	Invasive Fauna (Aquatic)	F,K,L,M	increase	
REDUCED CONNECTIVITY	Barriers to Fish Migration	F,K,L,M,G	increase	Reconnect floodplains, Modify Barriers
	Reduced Riparian Connectivity	F,K,L,M,G	increase	Reconnect floodplains
	Reduced Floodplain Connectivity	F,K,L,M	increase	Environmental Flows, Reconnect Floodplains

4.13.4 POSITION OF THE CATCHMENT MANAGEMENT AUTHORITY

The Goulburn Broken **Climate Change Integration Strategy** provided a framework for implementing the Goulburn Broken CMA climate change policies and actions.

The major recommendation which was developed and endorsed follows:

"In dealing with climate change and likely impacts, the Goulburn Broken CMA will focus on adaptation strategies to increase catchment resilience; greenhouse gas sequestration activity such as carbon brokering will be engaged for the purpose of assisting adaptation responses; and mitigation initiatives led by local government will be actively supported."

The outcomes and goals for the Climate Change Integration Strategy are summarised in the Table 4.11 below

Table 4.11 - Goulburn Broken CMA Climate Change Integration Strategy Outcomes and Goals

Outcomes	Goals
Integrate climate change into GB CMA programs	• 100% of all sub-strategies include climate change analysis and actions as they are renewed or developed. • 80% of biophysical projects include contributions to the Climate Change Integration Strategy's purpose in funding bids and reporting by 2015.
Improve understanding of climate change	• Adequate climate change information is available to add value to planning and investment decisions. • Improve the Goulburn Broken CMA's knowledge of potential impacts of climate change by initiating or partnering one climate change research project each year. • Quantitative measures that determine contribution to the Strategy's purpose are developed by 2015.
Pool and attract resources	• $2 million of new funds will be sourced for new projects through climate change funding programs by the Goulburn Broken CMA and its partners by 2015. • Increase the ability of organisations across the catchment to attract climate change funding, by partnering 6 climate change related projects led by other organisations by 2015.
Build catchment resilience into sequestration activities	• 100% of carbon sequestration activities undertaken by the GB CMA take into account and align with standards to promote resilience of the catchment by 2015. • The GB CMA encourages other government agencies and industry to take into account and align with standards to promote resilience of the catchment.
Support community mitigation efforts	• By 2013 the GB CMA will partner 4 community climate change organisations or agencies.
Minimise GB CMA footprint	• By 2012 the GB CMA will have updated its organisational environmental footprint framework (policy, procedures, action plan, monitoring, evaluating, reporting) • Develop targets for organisational environmental performance by June 2012. • Integrate environmental impact specifications into all contracts, tenders and purchasing guidelines by December 2012.

4.13.5 ADAPTATION

In the coming decades Victoria can expect:

- increased temperatures
- drier conditions
- more frequent extreme events such as extreme rainfall, bushfires and droughts.

Despite global and local efforts to reduce greenhouse gas emissions, some level of climate change is now inevitable. We need to adapt the way we do things to maintain Victoria's social, environmental and economic wellbeing.

Adapting to climate change means taking action to manage or reduce the consequences of a hotter, drier and more extreme climate. It also involves taking advantage of the opportunities these changes may present.

4.13.6 RECENT LEARNINGS

The Goulburn Broken Catchment Management Authority and partners have participated within a number of research projects to increase our understanding of the implications of climate change on waterway and catchment health. A summary of the conclusions of this work is shown in Table 4.12.

Table 4.12 – Conclusions in Adapting for Climate Change

Conclusion	Source
Adaptation measures at catchment scale should focus on pursuing existing natural resource management (NRM) actions in order to adapt an ecosystem-based approach that encourages "no regrets" ecosystem resilience by prioritising the protection and restoration of natural habitats. Specifically, this report highlights the high adaptation potential of six NRM actions: Restoration of riparian vegetation Freshwater habitat connectivity Conservation of more resilient habitats Conservation of gaining reaches Geomorphic restoration Management of exotic species	Identifying low risk climate change mitigation and adaptation in catchment management while avoiding unintended consequences. (NCCARF / CSU)
The resultant maps indicate the relative importance of different parts of the river network in a conservation sense, with color coding indicating the relative decrease in overall species occupancy patterns that would result from particular parts of the river network being removed	Comparison of state-wide and regional investment prioritisation based on freshwater fish conservation. (Monash University) Zonation Project
Key areas that should be prioritised for future research include improving predictions of stream flow under different climate scenarios and addressing the need for experimental data outside of historical climate conditions to which ecosystems have not yet been exposed.	Transferability of a modelling framework for the Upper Murrumbidgee Catchment to the Goulburn-Broken Catchment (NCCARF Canberra University)

4.13.7 ACTIONS FOR CLIMATE CHANGE

The Goulburn Broken Catchment Management Authority in partnership with the North East (CMA) have received funding under Stream 1 of the Australian Government's Regional NRM Planning for Climate Change Fund to undertake complementary projects that will identify:

- priority landscapes for climate change adaptation and mitigation;
- management actions to increase the resilience of these landscapes to climate change and other drivers of change; and
- identify risks and opportunities from market-driven carbon sequestration activities.

The project is entitled "Regional NRM Planning for Climate Change in the Goulburn Broken and North East - Spatial Assessment Tool" aims to assist CMA program managers and agency and community partners to develop responses to climate change that builds landscape and community resilience. It will also help the CMAs to understand risks associated with market-driven carbon farming projects and develop mitigation measures.

ACTION: Increase awareness of the impact of climate change and adaptation options.	
Responsibility: GB CMA, DEPI (Policy/waterways)	**Timeframe** 2013 - 2021

ACTION: Increase awareness of the impact of climate change on threats and resilience of systems at a range of scales.	
Responsibility: GB CMA, DEPI (Policy/waterways)	**Timeframe** 2013 - 2021

The **Goulburn Broken Climate Change Integration Strategy** (The Strategy) provided a framework for implementing the Goulburn Broken CMA climate change policies and action. In addition key implications have been derived from research projects currently involving the Authority. In undertaking this Waterway Strategy the following key actions are recommended, when considering the outcome of recent research and considering the influence of key threats to aquatic environments.

ACTION: Accelerate the rate of riparian maintenance and improvement works and flow management in priority waterways and wetlands	
Responsibility: GB CMA and community	**Timeframe** 2013 - 2021

ACTION: Accelerate the rate and encourage broad land based improvement works and actions (erosion and sediment control)	
Responsibility: DEPI and community	**Timeframe** 2013 - 2021

ACTION: Refine and maintain critical aquatic dependent refugia (consider Zonation Project)	
Responsibility: GB CMA, DEPI and community	**Timeframe** 2013 - 2021

ACTION: Model likely vegetation changes under climate change scenrios for waterway zone (by SES).	
Responsibility: Research Organisations, DEPI (Policy/waterways)	**Timeframe** 2013 - 2021

4.14 MANAGEMENT AND USE OF WATER STORAGES

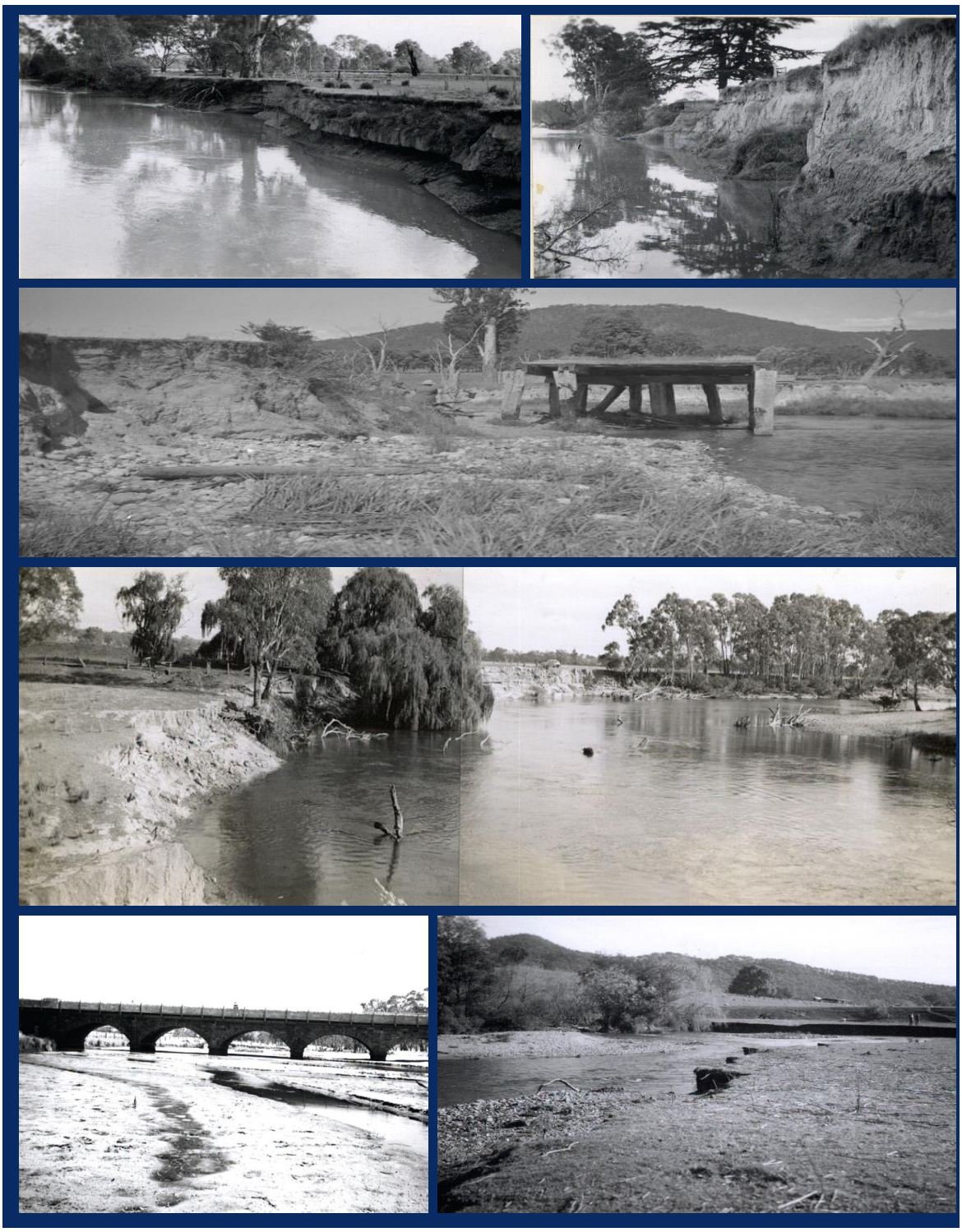
A number of major storages exist within the catchment for the purpose of harnessing and delivery of water. Many of these are located on-stream (ie Lake Eildon, Goulburn Weir, Waranga Basin, Lake Nillahcootie). The management of these lake systems are under the control of Goulburn Murray Water. Many waterways provide multiple purposes (environmental, cultural) and utilised for the converting of water for social and economic values (See Chapters 4.2 and 4.3).

Where recreational activities occur on water storages (DEPI, 2013b) that could threaten waterway condition, the relevant waterway manager / land manager will identify and manage those risks, where possible.

These areas are key site of on water recreation and tourism as well as being critical infrastructure for the supporting the region's primary agriculture and industries and in some instances minor flood mitigation.

Land and On-water Management Plans have been prepared for Lake Eildon, Nagambie Waterways, Lake Nillahcootie and Lake Mulwala within the Goulburn Broken Catchment. These 'Plans' provide a strategic approach to management of land and on-water issues. The intent of the plans are to better manage the increasing pressures on the important values of the lakes and associated foreshores, including community awareness and involvement, recreation, public access and safe use, environmental and cultural heritage and public land management. Implementation of the Land and On-water Management Plans will address a range of threats to the storages, and in turn protect key community, environmental and cultural values.

Operation of these storages can, at times, be a key threat to some values within receiving waters (see Chapter 6 and 7). Management of these storages need to recognise these values and minimise the effect on them.



Goulburn River (Seymour, 1958), Goulburn River (Seymour, 1958), Ryans Creek (1939), Goulburn River (Seymour, 1947), Hughes Creek (Avenel), Howqua River (1959) from our river heritage, Historic photos of Victoria's internal waterways - Our Water our Future

Goulburn River

PART B

Our Approach to the Strategy

CHAPTER FIVE:

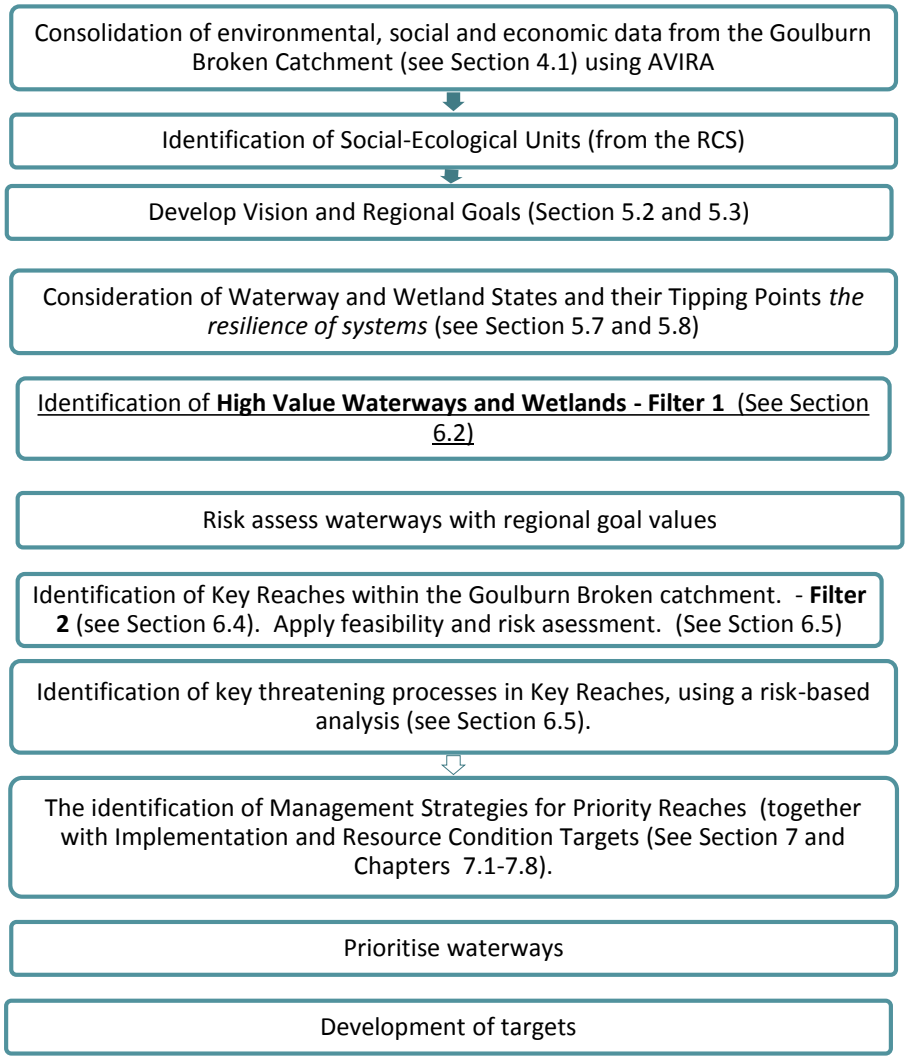
The Approach

This Chapter:
Sets the approach taken in the development of the Regional Waterway Strategy; and
Sets out the vision and key principles used in developing the strategy

5.1. OVERVIEW OF APPROACH

The Goulburn Broken Regional Waterway Strategy was prepared in accordance with the requirements of the Victorian Waterway Management Strategy (DEPI 2013b). The development of the Goulburn Broken Regional Waterway Strategy has involved a range of processes and has included information and input from the Regional Catchment Strategy (2012) planning process, regional planning group processes and the community. The Strategy has been developed to provide implementation detail to the high level outcomes within the Regional Catchment Strategy.

The Goulburn Broken Regional Waterway Strategy was produced incorporating the following key elements:



5.2 VISION AND REGIONAL GOALS

The regional Waterway Strategy requires a vision to guide its development and set its direction.

To ensure that the regional Waterway Strategy links to both the Victorian Waterway Management Strategy (2013) and the Goulburn Broken Regional Catchment Strategy (2013), their visions were used as a starting point.

The Vision for Victoria's waterways is:

Victoria's rivers, estuaries and wetlands are healthy and well-managed; supporting environmental, social, cultural and economic values that are able to be enjoyed by all communities.

The Vision for the Goulburn Broken Catchment is:

Healthy, resilient and increasingly productive landscapes supporting vibrant communities.

Based on the above, the Vision for the Region's Waterways and Wetlands is:

Resilient Waterways, Vibrant Communities.

The Goulburn Broken region's waterways and wetland systems are vibrant and resilient, so that communities can enjoy the range of values and benefits that they provide and contribute to their maintenance and improvement

5.2.1 REGIONAL GOALS

To assist in setting broad directions for management and identifying priority waterways in the Goulburn-Broken region, a set of high-level goals were developed as follows:

Maintain and Improve the resilience of the region's waterways:

Social

- Maintain or improve waterways of high community value.

Economic

- Maintain or improve water quality in priority water supply catchments.

Environment

- Populations of threatened aquatic dependent species will be maintained or improved- including Trout cod, Macquarie perch, Murray cod, Eel tailed catfish, *Barred galaxias*, Golden perch.
- Barmah Forest (Ramsar site) will retain its ecological character.
- The values associated with Heritage Rivers will be maintained or improved.
- Wetlands with formally recognised significance are maintained or improved.
- Rivers in a near natural or ecologically healthy state are retained.

Urban Waterways

- Urban waterways are managed to improve environmental condition, amenity and water security.

In general, the regional goals were developed to:

- apply to a timeframe generally longer than 20 years;
- have a conceptual or qualitative links to management outcomes; and
- be region wide.

5.3 AQUATIC VALUE IDENTIFICATION AND RISK ASSESSMENT (AVIRA) – THE ASSET BASED APPROACH

Threat-based approaches to natural resource management, have lessened across Australia over the past decade, and has been replaced with asset-based approaches. With Asset based approaches focus on important natural 'assets', rather than on threat-based issues.

AVIRA (Aquatic Value Identification and Risk Assessment) is the framework that contains information on waterway and wetland assets and threats and applies a risk assessment processes to assist in the planning for waterway management activities.

AVIRA is an update of the RiVERS[4] decision support tool which was utilised in the development of the first Regional Waterway Strategies) and will inform the development of the Regional River Health Strategies (RRHSs) across Victoria.

The AVIRA decision-support tool has been developed to replace the RiVERS decision-support tool. RiVERS was an asset inventory that documented the social, economic and environmental assets (what we now call 'values'), and the threats to these assets (values), for rivers across the state.

AVIRA stores information on the environmental, social and economic values of rivers (see Appendix B), but will also include information on the values of selected estuary and wetland assets. For each asset, AVIRA stores information on the threats to these values and conducts an automated risk assessment for every value/threat combination. AVIRA undertakes the first four of the steps of the asset based approach outlined above.

AVIRA was used to inform priority setting for the development of this Strategy. AVIRA also incorporated a risk based assessment for all waterways.

The data contained in the AVIRA database is considered the best available at the time of preparation of this Regional Waterway Strategy. The list of assets and threats contained in AVIRA is shown in Appendix B.

5.4 MANAGING FOR WATERWAY RESILIENCE

"…….Resilience is the capacity of a system and a system can be an individual person, it could be a regional catchment or it could be a country. It is the capacity of that system to absorb the disturbance or shock and then to keep functioning in much the same kind of way……." (A definition by Brian Walker).

By applying the resilience approach the strategy aims to maintain, where possible enhance the values contained within a river or wetland system. By applying this approach the system will be managed rather than an individual aspect or value for the benefit of current and future generations.

The resilience of our waterways is dependent achievement of the high level outputs and outcomes identified within the Regional Catchment Strategy. These will be achieved through the delivery of the actions contained within this Waterway Strategy.

The Stratgy has considered the resilience of our waterways to:

- determine if waterways are in the state in which we desire
- determine measures required to maintain resilience
- determine if / which waterways are close to a tipping point.

It is clear that waterway values exist across the range of stream states. For example threatened species and waterway recreation exist in near natural and working rivers. Prior to the implemnentation of works stream condition, current state, and desired stated, the values that exist within the stream all need to be taken into account when deciding on the appropriate management strategies. Often all threats may not need to be addressed to reach the desired condition or state.

It is clear that we need to understrand the current state of the waterway and a determined future state in order for us to determine what measures need to be employed.

[4] RiVERS is a database application developed for the Victorian Catchment Management Authorities which was utilised to assist in developing Regional River Health Strategies and prioritising waterway management activities using a risk-based management approach.

5.4.1 WATERWAY AND WETLAND STATES, DIFFERING ENVIRONMENTAL CONDITION, SUPPORTING VALUES AND TYPICAL USES

Notionally there are a number of possible states for waterways and wetlands depending on their condition, intrinsic values and typical use.

Four states have been identified (refer to Victorian Waterway Management Strategy, 2013); near natural, ecologically healthy, sustainable working and highly modified. While the majority of our waterways are in a sustainable working or highly modified state and have suffered a loss of biodiversity or a loss of ecological functions, some to maintain near natural or ecological characteristics (refer to Table 5.1). All systems support important social and economic values. Furthermore the environmental, social and economic values are not static - as they could change through natural environmental cycles (such as droughts, fires and floods) and with changes to community expectations, needs and values.

In the development of this Strategy, waterways and wetlands have been categorised into one of the four states (as described by DEPI, 2013b) in Table 5.1 below.

The resilience of our waterways is dependent on the delivery of the actions contained within this Waterway Strategy and delivery of the high level outputs and outcomes identified within the Regional Catchment Strategy.

Table 5.1 River and wetland ecosystem states

State	Near Natural	Ecologically Healthy	Sustainable Working	Highly Modified / Degraded
Values	High degree of naturalness, moderate-low recreational, wilderness, tourism	High degree of naturalness, high recreational and tourism, water supply	Moderate naturalness, some significant species, high recreational and tourism, water supply and delivery, low to medium agriculture and /or urban pressure	Low level of naturalness, moderate recreational and tourism, intensive production, high flow modification / water supply, agriculture or urban pressure high
Modification	Very Low	Low	Moderate	Moderate to high
Basis - ISC (2010)	50-45	44-35	34-21	20-0
				
Examples	Big River R68 / Ryans Creek R 17	Howqua River R70 / Yea River 55-57	Seven Creeks / Hollands Creek R14	Goulburn River R 1-9 / Mollisons Creek R42,43
Naturalness	Very High	High	Med	Low-Very Low
Socio Economic	Low	Low	High	High

ISC Rating	Excellent	Good	Moderate	Poor	Very Poor
ISC 1999	42 - 50	35 – 41	26 – 34	20 –25	0 – 19
ISC 2004	37 – 50	29 – 36	19 - 28	14 – 18	0 - 13
ISC 2010	40 - 50	35 - 39	25 - 34	20 -24	0 - 19

Utilising the data contained within the Index of Stream Condition (Appendix D) and by applying the rules from the Table above, the waterways which are close to “tipping point” is shown in Table 5.2 below.

Table 5.2 streams approaching a tipping point. By applying/utilising the ISC

State (Current)	Rules Applied	Waterways	Approaching "State"
Near Natural	ISC (at 45 - 46)	(none)	Ecological Healthy
Ecologically Healthy	ISC (at 35 -36)	Goulburn River (5-15), Acheron River (5-62), Rubicon River (5-65), Howqua River (5-69) and Delatite River (5-72)	Sustainable Working
Sustainable Working	ISC (at 21 – 22)	Creightons Creek (5-27), Deep Creek (5-34), Dairy Creek (5-53), Delatite River (5-71) and Kurkurac Creek (5-78)	Highly Modified

Waterways within the region, over the past decade have been subjected to shocks (drought, fire and flood). Overall they have been remarkably resilient. Key drivers likely to impact on the region's waterways over the life of this strategy include floods and fire (Figure 5.3). These key shocks are unlikely to see our waterways and wetlands approach a tipping point and move to an alternative state.

For each waterway within AVIRA a state has been assigned based on the Index of Stream Condition. These states are shown in Appendix D

5.4.2 TIPPING POINTS

The following table (5.3 below) summarise stream states (key characteristics), values provided together with the key shocks and thresholds which may bring about a change in state (tipping point).

Table 5.3 – States, Shocks, Drivers and Tipping Points

State	Key Characteristics	Main values delivered
Near Natural / Pristine	in the river and riparian zone, all plant and animal species are native (no exotic species exists within the system); • natural ecosystem processes are maintained; • major natural habitat features are represented and are maintained over time; • native riparian vegetation communities exist sustainably for the majority of its length	Good water quality, Aesthetics, Native Flora and Fauna, Cultural, Natural Flow (quantity), Refugia
Shocks	**Drivers**	**Thresholds**
Fire.	Climate	Encroachment of pest plants, Pest animals

State	Key Characteristics	Main values delivered
Near Ecologically Healthy	in the river and riparian zone, the majority of plant and animal species are native minimal exotic species exists the system; • natural ecosystem processes are maintained; • major natural habitat features are represented and are maintained over time; • native riparian vegetation communities exist sustainably for the majority of its length	Good water quality, Aesthetics, Native Flora and Fauna, Exotic Flora and Fauna, Cultural
Shocks	**Drivers**	**Thresholds**
Fire, Floods	Climate, Land development, population, land use intensification	Changed channel hydrology, Channel modification, Changed riparian / adjacent landuse

State	Key Characteristics	Main values delivered
Sustainable / Working	in the river and riparian zone, native and exotic plant and animal species are present; • major natural habitat features are modified • linkages between river and floodplain and associated wetlands are often modified; • native riparian vegetation communities modified for majority of its length • adjacent land use modified • flow regimes – slightly to highly modified	Tourism / recreation, Provision of water supply, Native and exotic Flora and Fauna, Cultural
Shocks	**Drivers**	**Thresholds**
Fire. Floods	Climate, Land development, population, land use intensification	Landuse change, channel modification, changes to flow regimes, changes to riparian zones.

State	Key Characteristics	Main values delivered
Highly Modified / Degraded	in the river and riparian zone, native plants have been highly modified / removed or dominated by exotic species • natural ecosystem processes are highly modified; • major natural habitat features are highly modified • linkages between river and floodplain and associated wetlands are highly modified; • adjacent land use highly modified flow regimes – highly modified	Tourism / recreation, Provision of water supply, Cultural, Heritage, Urban recreation.

There remain many knowledge gaps with respect of waterway resilience, specifically relating condition, trends and their associated tipping points. Improvement of these knowledge gaps have been prioritised and will be undertaken as resources are identified during the life of this Strategy.

Action	Timeframe	Responsibility
Further refine States and Tipping points at SES, reach and asset scales.	2015	GB CMA, Educational Institutions, Researchers.

Action	Timeframe	Responsibility
Enhance reliance of those waterways approaching a "tipping point" based on the ISC through delivery of priority actions in Chapter 7	2013 - 2021	GB CMA, G-MW, PV, Municipal Government, DEPI (regional), Community.

CHAPTER SIX:

Priority Setting

This Chapter:
Sets the approach taken to establish priority waterways within the Strategy

6.1 IDENTIFYING AND RANKING PRIORITY WATERWAYS

Waterways within the Goulburn-Broken region provide our community with an immense array of values. These include environmental (e.g. native fish, vegetation), economic (e.g. water supply, supporting agriculture and production) and social (e.g. recreation, aesthetics). There are also a number of threats which currently and have further potential to impact on these values.

Whilst we would like to rehabilitate all waterways in the region, we don't have the necessary resources (people, dollars, time) to complete such a task. Therefore, we have to find some way of allocating the available resources to the region's highest priority waterways.

The key goal of the Strategy is to identify priority waterways for investment over the next eight years to ensure that we maintain the resilience of these systems which will in turn maintain and improve the values they provide, these being social, environmental, cultural and social.

6.2 DEFINING WATERWAYS

6.2.1 ASSETS

Identifying and ranking priority waterways in the Goulburn Region was informed by the Aquatic Value Identification and Risk Assessment (AVIRA) decision support tool. AVIRA is an asset inventory, which:

- documents the environmental, social and economic values and threats associated with waterway assets (river reaches, wetlands and estuaries); and
- assesses risks to values to assist in the planning for waterway management activities.

For the Goulburn-Broken region, 117 river reaches and 162 wetlands were assessed using data from the 3ISC (Index of Stream Condition) and IWC (Index of Wetland Condition). This data was considered the best and most comprehensive information available at the time of Strategy preparation.

6.2.2 MANAGEMENT UNITS

Seven management units (titled Social Ecological Systems – SESs or Landscapes) were established for the Goulburn Broken region during consultation with the community as part of the Regional Catchment Strategy process.

SESs describe the linked social and ecological systems in which we all live, within the Goulburn Broken catchment. SESs can be described at a number of scales and encompasses the social, ecological, economic, political, cultural and biophysical system components and acknowledge their inter-linkages and inter-dependencies. Understanding SESs and identifying their drivers, threats and thresholds helps managers to develop strategies to keep the system within limits, where appropriate.

The six SESs or Landscapes shown in Figure 6.1 have been adopted as the key management units for the Strategy.

6.3 IDENTIFYING HIGH VALUE WATERWAYS

The Victorian Waterway Management Strategy (2013) states that waterways will be considered high value if they have one, or more, of the following characteristics:

- formally recognised significance
- presence of highly threatened or rare species and communities
- high naturalness values (for example, aquatic invertebrate communities and riparian vegetation) or special waterway features (for example, drought refuges and important bird habitat)
- high social, cultural and economic values (for example, recreational fishing, Aboriginal cultural heritage, urban/rural water sources).

For waterway assets in AVIRA, the above characteristics can be assessed using specific scoring rules as detailed in Appendix C. If a waterway meets one or more of these scoring rules, it is considered to be a high value waterway.

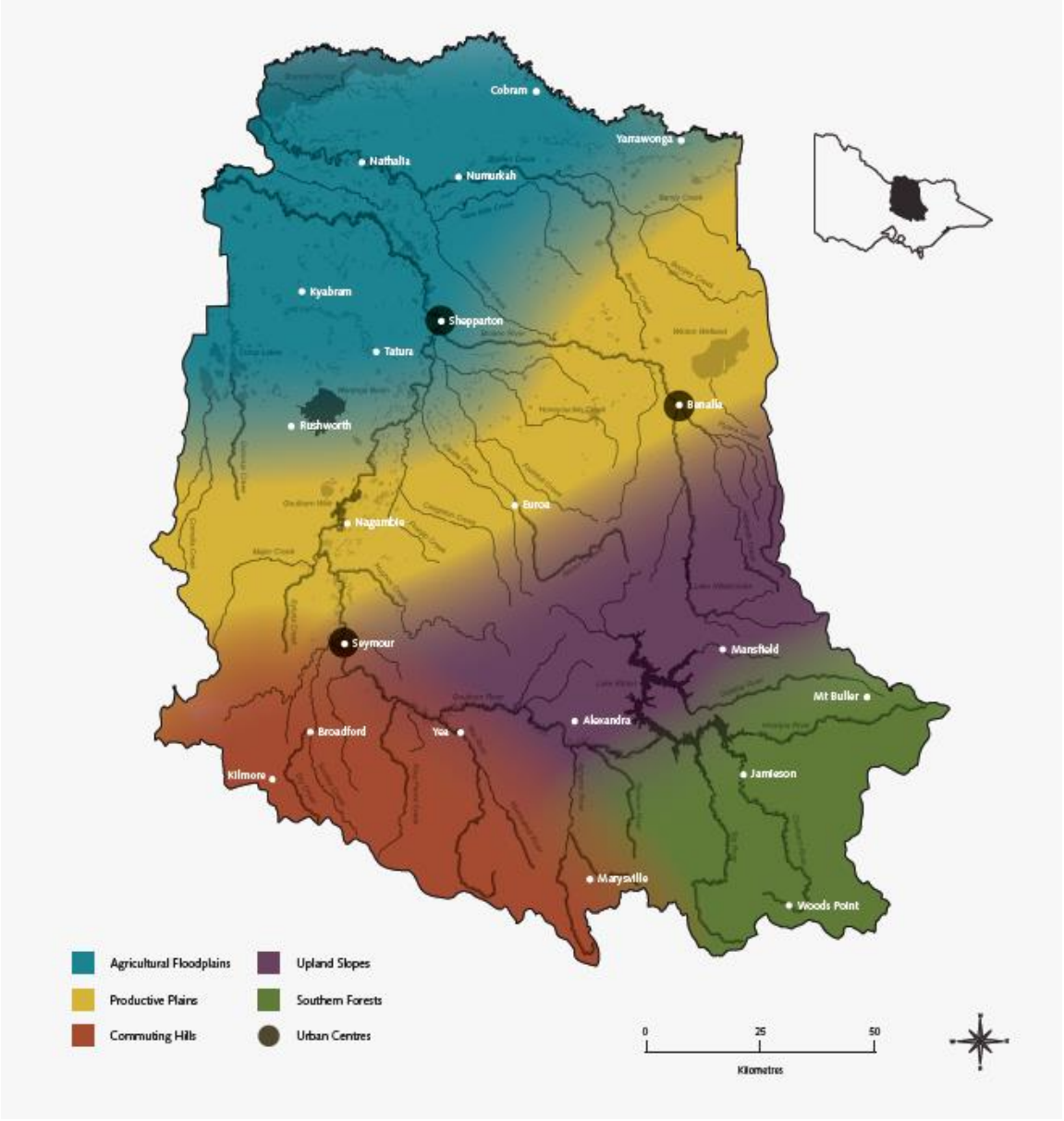


Figure 6.1 - Social Ecological Systems of the Goulburn-Broken Region

6.3.1 RESULTS

Using the scoring rules detailed in Appendix C:

- all 117 river reaches in the Goulburn-Broken region were identified as high value waterways; and
- 59 of 162 wetlands in the Goulburn-Broken region were identified as high value wetlands.

These results are summarised by SES (Landscape) in Appendix E and summarised by SES (Landscape) in Table 6.3.

Table 6.1- For the Goulburn Broken region, - High Value Waterways and Wetlands

Socio-Ecological System	Number of High Value Waterways	Number of High Value Wetlands
Agricultural Floodplains	18	59
Productive Plains	43	
Upland Slopes	21	
Commuting Hills	23	
Southern Forests	12	

This is still too many waterways to manage over the next eight years. Hence we filter high value waterways and wetlands against regional goals (see Step 4).

6.4 PRIORITY WATERWAYS AND WETLANDS

As shown in Table 6.1, a high percentage of waterways within the region were identified as high value waterways. In order to develop a realistic 8 year regional work program, this percentage must be reduced and prioritised.

The approach adopted was to identify which high value waterways were linked to the regional goals. This involved the identification of relevant and/or attributable AVIRA values and determination of scoring cut-offs (or rules).

AVIRA rules for linking high value waterways to regional goals are detailed in Table 6.2, 6.3 and 6.4. AVIRA rules could not be developed for the urban waterways goal.

Table 6.2 - AVIRA Rules for Social Goals

Regional Goal	Approach	AVIRA Rule
Maintain and improve waterways of high community value	Maintain or improve waterways with multiple social benefits, indicative of use by a broad cross section of the community.	Rank waterways based on the number of values met under the AVIRA social category: activity. A waterway will be considered to have met the goal if: • it has 4 or more high value attributes under the AVIRA social category: activity

Table 6.3 - AVIRA Rules for Economic Goals

Regional Goal	Approach	AVIRA Rule
Maintain and improve water quality in priority water supply catchments	Maintain or improve waterways within Special Water Supply catchments.	Include waterways within Special Water Supply Catchments, under the Catchment and Land Protection Act 1994. AVIRA identifies waterways within Special Water Supply Catchments with a score of 4 (open SWSC) or 5 (closed SWSC) for the 'urban/rural township water sources' value

Table 6.4 - AVIRA Rules for Environmental Goals

Regional Goal	Approach	AVIRA Rule
Populations of threatened aquatic dependent species will be maintained or improved- including Trout cod, Macquarie perch, Murray cod, Eel tailed Catfish, *Barred galaxias*, Golden perch.	Maintain or improve the resilience of known populations of Trout cod, Macquarie perch, Murray cod, Eel tailed Catfish, *Barred galaxias*, Golden perch.	Include waterways with: • One or more critically endangered or endangered fish species present OR • Three or more threatened fish species present (vulnerable or greater)
	Maintain or improve the resilience of known populations of other significant waterway dependent species.	Include waterways with: • One or more critically endangered species present OR • Two or more endangered species present

		OR Four or more threatened species present (vulnerable or greater)
Barmah Forest will retain its ecological character	Maintain or improve the listed values of Barmah Forest.	Include waterways listed as a key feature of the Ramsar site
The values associated with Heritage Rivers will be maintained or improved	Maintain or improve the listed values of heritage rivers.	Include river reaches that form part of a Heritage River.
Wetlands with formally recognised significance are maintained or improved	Maintain or improve the condition of values of Living Murray Icon Sites.	Include waterways listed as a key feature of a Living Murray Icon Site.
	Maintain or improve the condition of values of DIWA wetlands.	Include waterways listed as regionally important wetlands within the RCS.
Rivers in a near natural or ecologically healthy state are retained	Protect all environmental values of near natural or near ecologically healthy rivers.	Near natural river reaches: • 3ISC Environmental Condition – Excellent AND • no motor boating, wastewater discharge, water carrier, commercial fishing or extractive industries Near ecologically healthy river reaches: • 3ISC Environmental Condition – Good AND no motor boating, wastewater discharge, water carrier, commercial fishing or extractive industries

In addition this step considered the risk based assessment undertaken within AVIRA, see Chapter 6.5 below.

6.4.1 RESULTS

Using the AVIRA rules described in Tables 6.2, 6.3 and 6.4 the following refinement of high value waterways was achieved:

- river reaches. From 117 high value waterways to 64 key waterways.
- wetlands. From 59 high value wetlands to 17 key wetlands.

These results are summarised by SES (Landscape) in Table 6.5 and Figure 6.2 and detailed in Appendix F.

Tables 6.5 Key Waterways and Wetlands in the Goulburn Broken Catchment, by Landscape

AGRICULTURAL FLOODPLAINS		
5-02	Goulburn River	
4-36	Tullah Creek	
4-32	Boosey Creek	
5-01	Goulburn River	
4-01	Broken River	
5-04	Goulburn River	
5-05	Goulburn River	
5-03	Goulburn River	
4-23	Broken Creek	
4-24	Broken Creek	
4-22	Broken Creek	
4-21	Broken Creek	
5~34~W1	553130116015289	Barmah Wetland
6~1~W1	7824054566	Gaynors Swamp
5~1~W4	7825119977	Kaynapella Basin
	7825193998	unnamed wetland
6~1~W2	7825094647	Mansfields Swamp
	553163656023964	Barmah Wetland
5~8~W1	7924374458	Doctors Swamp
5~5~W1	7925521729	Gemmills Swamp
5~4~W6	7925531768	Reedy Swamp
4~30~W1	7925607991	Black Swamp
	7925619057	unnamed wetland
4~32~W8	8025020980	Sampys Swamp
4~32~W9	8025035990	Taylors Swamp
	8025970032	unnamed wetland

PRODUCTIVE PLAINS	
4-13	Holland Creek
5-08	Goulburn River
5-39	Hughes Creek
5-17	Seven Creeks
5-37	Hughes Creek
5-18	Seven Creeks
5-06	Goulburn River
5-38	Hughes Creek
4-34	Boosey Creek
5-07	Goulburn River
5-10	Goulburn River
5-19	Seven Creeks
5-09	Goulburn River
5-23	Honeysuckle Creek
5-20	Seven Creeks
5-22	Honeysuckle Creek
4-03	Broken River
4-08	Five Mile Creek
4~24~W4 / 8125130040	Dowdle Swamp
4-20-WS1 / 8125180650 Complex	Winton Wetland

UPLAND SLOPES	
4-14	Holland Creek
5-62	Acheron River
4-05	Broken River
5-13	Goulburn River
5-74	Brankeet Creek
4-04	Broken River
4-10	Lima East Creek
4-17	Ryans Creek
5-14	Goulburn River
4-16	Ryans Creek
5-75	Merton Creek
4-06	Broken River
4-11	Sawpit Gully Creek

COMMUTING HILLS	
5-42	Mollison Creek
5-51	King Parrot Creek
5-55	Yea River
5-56	Yea River
5-43	Mollison Creek
5-12	Goulburn River
5-47	Sunday Creek
5-11	Goulburn River
5-47	Sunday Creek

SOUTHERN FORESTS	
5-65	Rubicon River
5-67	Big River
5-68	Big River
5-70	Howqua River
5-69	Howqua River
5-71	Delatite River

5-15	Goulburn River
5-16	Goulburn River
5-64	Taggerty River
5-66	Rubicon River
5-63	Acheron River
5-72	Delatite River
CHP	Central Highland Peatlands

Figure 6.2 –Key Waterways and Wetlands within each Landscape

6.5 RANKING WATERWAYS

6.5.1 APPROACH

Assessing Risks

Within AVIRA, a risk assessment is undertaken for each waterway e.g. for each river reach, 38 values are assessed against 22 threats, resulting in 836 risk level assessments.

On this basis, for each high value waterway with links to one or more regional goals, the following approach was taken:

1. Identify all threats to high value attributes (linked to regional goals) where the recommended treatment is 'Reduce Threat' (see Figure 6.3 below – Risk Assessment Extract from AVIRA).
2. Determine a 'first cut' of the feasibility (high, medium, low) of reducing each threat.

Priority for the development of the regional works program should then be given to:

- waterways with higher scores (in general these have significant value and management of the threats is feasible); and
- waterways with very low scores (in general these are waterways with minimal threats that just require maintenance.

A summary of recommended actions from the regional priority setting processes is as follows:

	Low Risk to Values	High Risk to Values
High Value Waterways	Actions to Maintain Values	Actions to Reduce Threats to Values (Threat to Waterway resilience)
Other Waterways	Not a Priority	Actions only if waterway: • is a threat to High Value Waterway • provides connectivity • threatens public infrastructure • has strong community commitment

Considering Technical Feasibility

For each identified risk, a 'first cut' of the technical feasibility (high, medium, low) of reducing each threat (i.e. implementing on-ground actions) was determined. Social and/or economic factors were assessed later when developing the works program.

Calculating a Priority Waterway Score

To calculate the score for a priority waterway, raw scores were calculated for each risk/feasibility combination as follows:

raw score = risk level x feasibility

where: risk level = 5–very high, 4-high, 3-moderate, 2-low, 1-very low
feasibility score = 3–high, 2–medium, 1–low

All raw scores for a waterway were then added and the total divided by the number of raw scores calculated. This produced a Priority Waterway Score (ranging from 0 and 15). From this a Priority List of Waterways can be established.

Once Priority Waterway Scores were calculated for each priority waterway, the waterways could be ranked from highest score to lowest score.

5-05	Goulburn River								Priority Waterway Score	#DIV/0!

High Value Waterway Status

Type	Category	Status
Environmental	Formally Recognised Significance	x
	Representativeness	
	Rare or Threatened Species/Communities	x
	Naturalness	
	Landscape Features	x
Social	Activity	x
	Place	
	People	x
Economic	Water	x
	Power Generation	
	Other Resources	

Links to Regional Goals

Goal	Link
Protect all populations of threatened aquatic dependent fauna species within known locations	x
Retain the ecologcal character of Barmah Forest/Wetland	
Protect and improve the values associated with Heritage Rivers	x
Enhance urban waterways in partnership with local government (aligned with community expectations and values)	
Protect and enhance wetlands with recognised conservation significance	
Protect rivers in pristine and near ecologically healthy status	
Maintain and improve water quality in high priority water supply catchments	
Maintain high value recreation areas	x

Risk Assessment

										Feasibility		
Type	Value Name	Value Scc	Goal Lin	Threat Name	Threat Scc	Associati	Confider	Risk Leve	Treatment	High	Modera	Low
Environmental	Significant Amphibians	5	x	Invasive Fauna (Aquatic)	5	High	High	Very High	Reduce Threat Level			
Environmental	Significant EVCs	5	x	Invasive Fauna (Terrestrial)	5	High	High	Very High	Reduce Threat Level			
Environmental	Significant Fish Migratory	5	x	Inc in Low Flow Magnitude	5	High	High	Very High	Reduce Threat Level			
Environmental	Significant Fish Migratory	5	x	Inc in Prop of Zero Flow	5	High	High	Very High	Reduce Threat Level			
Environmental	Significant Fish Migratory	5	x	Invasive Fauna (Aquatic)	5	High	High	Very High	Reduce Threat Level			
Social	Motor Boating	5	x	Inc in Prop of Zero Flow	5	High	Low	Very High	Reduce Threat Level			
Social	Recreational Fishing	5	x	Inc in Prop of Zero Flow	5	High	Low	Very High	Reduce Threat Level			
Social	Recreational Fishing	5	x	Invasive Fauna (Aquatic)	5	High	Low	Very High	Reduce Threat Level			

Figure 6.3 - Priority Waterways - Risks and Feasibilities Example

6.6 IDENTIFICATION OF MANAGEMENT STRATEGIES FOR PRIORITY REACHES

This Chapter establishes the strategic understanding of the management activities/strategies required to reduce the threats to values

The basis of this work is the Conceptual Model Project (GHD, 2012) that produced a set of conceptual models that will provide consistent assumptions about the relationships between values and threats and the management activities required to reduce threats to values.

The conceptual models will provide consistent, and as far as possible evidence-based, assumptions on the relationships between values and threats; management objectives to reduce the threats to values and the management activities required to achieve particular specified outcomes

The following matrix Figure 6.4, (GHD, 2012) identifies management strategy options to maintain waterways and/or reduce high risk threats.

Management strategies to mitigate threats are rated on the confidence in the approach and temporal response of the management activity to mitigate the threat.

Temporal responses have been developed to align with the timeframe of the RWSs. Temporal responses have been scored as a 1, 2 or 3 where the scores are defined as:

Temporal Rating	Clarifier
1	Expected response to management activity less than one year
2	Expected response to management activity in 1-8 years
3	Expected response to management activity greater than 8 years

Confidence in the effectiveness of the management activity to treat the threat has been defined as High or Medium which are defined as follows:

Confidence Ratings	Clarifier
High	Repeated scientific evidence supports association rating
Medium	Expert/professional opinion based on logical/plausible connection rather than direct evidence

Figure 6.4 - (GHD, 2012) identifies management strategy options to maintain waterways and/or reduce high risk threat

	Most Used On-Ground Works																	Other Works			
Threats to River Reaches	Aquatic Weed Control	Buffer Strip Establishment	Environmental Water	Fencing Remnants	Grazing Regime Change	Natural Regeneration	Off Stream Watering	Pest Animal Management	Pest Plant Control	Revegetation	Soil Erosion Control	Stream Bank Stabilisation	Stream Bed Stabilisation	Fish Passage	Urban Stormwater Management	Wetland Watering Regime Changed	Re-snagging streams	Fire Regime Change	Soil Conservation	Stock Containment
ALTERED WATER REGIMES																				
Altered Flow Regimes																				
Increase in Low Flow Magnitude			H1																	
Reduction in High Flow Magnitude			H1																	
Increase in Proportion of Zero Flow			H1																	
Change in Monthly Stream flow Variability			H1													M2				
Altered Stream flow Seasonality			H1													H1				
ALTERED PHYSICAL FORM																				
Bank Instability		H2		H2	H2	H2	M2			H2	H2	H1	M2							H2
Bed Instability (Degradation)					H2					M2	H2	H2	H1							H2
POOR WATER QUALITY																				
Degraded Water Quality		H2			H2		M2			H2	H2	H1	H1		H1				H2	H2
Thermal Water Pollution																				
Disturbance of Acid Sulphate Soils																				

	Most Used On-Ground Works																		Other Works	
Threats to River Reaches	Aquatic Weed Control	Buffer Strip Establishment	Environmental Water	Fencing Remnants	Grazing Regime Change	Natural Regeneration	Off Stream Watering	Pest Animal Management	Pest Plant Control	Revegetation	Soil Erosion Control	Stream Bank Stabilisation	Stream Bed Stabilisation	Fish Passage	Urban Stormwater Management	Wetland Watering Regime Changed	Re-snagging streams	Fire Regime Change	Soil Conservation	Stock Containment
DEGRADED HABITATS																				
Degraded Riparian Vegetation		H2		H2	H1	H2	H2			H2		H1						H2		H1
Large Trees					H3		M3		M3	H3		M1						M1		M3
Loss of In stream Habitat										H3										
Large Wood		H2								H3							H1			
Sedimentation		H2			H2		M2				H2	H2	H1						H2	
Livestock Access				M3	M2	H2	H1			H1										H2
INVASIVE FLORA AND FAUNA																				
Invasive Flora (Riparian)				H	H	H2	M2		H1	M2		H1						H2		M2
Trees		M2		H1	H3	H3	M3		H1	M2		H1						H2		M3
Shrub Layer		M2		H2	H2	H2	M2		H1	M2		H1						H1		M2
Ground Layer		M1		H3	H2	H1	M1		H1	M2		H1						H1		M1
Invasive Flora (Aquatic)	H1				H2				H1											M1
Invasive Fauna (Terrestrial)								H2												
Invasive Fauna (Aquatic)			M2					H1												
REDUCED CONNECTIVITY																				
Barriers to Fish Migration														H1						
Reduced Riparian Connectivity				M3		H2														
Longitudinal Continuity		H2		M2	H	H2	M2	2	M2			M2						H2		H2
Vegetation width		H2		H	H	H2	H2	M2	M2			H1						H1		H2
Reduced Floodplain Connectivity			H1													H1				

Gooram Falls

PART C

Regional Program – Priority Waterways /works and activities

CHAPTER SEVEN:

The Action Plan

This Chapter:

Introduces priority waterways and wetlands, identifies values and threats and identifies strategic directions for their maintenance and enhancement.
Sets out the vision (50 year), key principles and methods used in developing the strategy.
Defines high level (20 year) goals2 for waterways in the region
Commences the introduction of the proposed works and implementation plan

7.1 REGIONAL WORK PROGRAM (8-YEAR WORK PROGRAM)

The following Chapter introduces the six major Social-Ecological Systems (SES) within the Goulburn Broken Region. Each Unit includes a description of the values, threats and risks to the environmental, economic and social value of priority waterways and wetlands together with Strategic Priorities, Management Objectives and Implementation Targets.

Social Ecological Systems (SES) describe the linked social and ecological systems in which we all live, within the Goulburn Broken catchment. SESs can be described at a number of scales and encompasses the social, ecological, economic, political, cultural and biophysical system components and acknowledge their inter-linkages and inter-dependencies. Understanding SESs and identifying their drivers, threats and thresholds helps managers to develop strategies to keep the system within limits, where appropriate.

The construct of the six Social Ecological Systems were established during consultation with the community as part of the Regional Catchment Strategy process. These have been adopted as the key management Units for the Regional Waterway Management Strategy.

1. Agricultural Floodplains
2. Productive Plains
3. Upland Slopes
4. Commuting Hills
5. Southern Forests
6. Urban Centres
7. Catchment Wide SES (See Challenges and Opportunities – Chapter 4)

7.1.1 RESOURCING THE STRATEGY

The implementation of this waterway strategy will be influenced by available funding and resources, level of community support and the impacts of extreme events within the region. Investment proposals to support actions within the strategy will be developed as investment opportunities arise. Where relevant, project investment proposals will be prepared in conjunction with delivery partners and the community.

7.2 AGRICULTURAL FLOODPLAINS

The Agricultural Floodplains encompasses the low lying floodplains, with some sandhills, along the valleys of the River Murray and Goulburn River. The river floodplain systems are a dominant feature across the landscape.

Regulation, and the associated timing and volume of flow delivery in channels and across the floodplain is the greatest threat to waterways, which are typically highly modified from their original state. Most waterways are currently in poor condition. Priority waterway assets are:

Goulburn River: A Heritage River associated with wetlands of national significance supporting threatened species including Murray Cod, Silver Perch and Macquarie Perch. It contains many cultural heritage sites and provides water for agriculture, urban and recreational use.

Gobarup Creek: Associated with wetlands of national significance.

Broken River: Associated with wetlands of national significance and supports the threatened Murray Cod, Macquarie Perch and Silver Perch.

Broken Creek: Supports the threatened Murray Cod and is associated with wetlands of Wetlands form a critical part of the river ecosystems of the Agricultural Floodplains.

Current wetland condition is generally moderate to good. Wetlands on public land are in better condition than private land, where they are considered to be in generally a poor state. The biggest threats to this state are river regulation, inadequate drainage and landforming. Priority wetlands assets are:

Barmah Forest (Ramsar listed/ The Living Murray (TLM) Icon Site): Along with the adjoining Millewa forest in NSW, it forms the largest River Red Gum forest in the world. It is one of Victoria's largest waterbird breeding areas and maintains 38 rare or threatened plant species.

Kanyapella Basin (Directory of Important Wetlands of Australia (DIWA) listed): Mixed River Red Gum forest and Black Box woodland which maintains the nationally threatened River Swamp Wallaby Grass and provides flood retardation.

Gaynor Swamp (DIWA listed): A large Red Gum lignum swamp that supports tens of thousands of water birds.

Wanalta Wetland Complex (DIWA listed/Bioregional): Four hydrologically connected wetlands valued for their size, rarity, species diversity and waterbird habitat.

Reedy Swamp (DIWA listed): A significant breeding area for colonial nesting waterbirds including the threatened Royal Spoonbill. It provides important drought refuge.

Kinnairds Swamp (Regional): A Red Gum swamp that maintains the largest known population of the nationally threatened Rigid Water Milfoil in Victoria. It provides important breeding habitat for waterbirds including the threatened Royal Spoonbill.

Black Swamp (Bioregional): A small Red Gum swamp that maintains the nationally threatened River Swamp Wallaby Grass and Australasian Bittern.

Other wetlands of formal significance within the Agricultural Floodplain SES include: **Mansfields Swamp. Gemmills Swamp, Sampy's Swamp and Taylors Swamp**.

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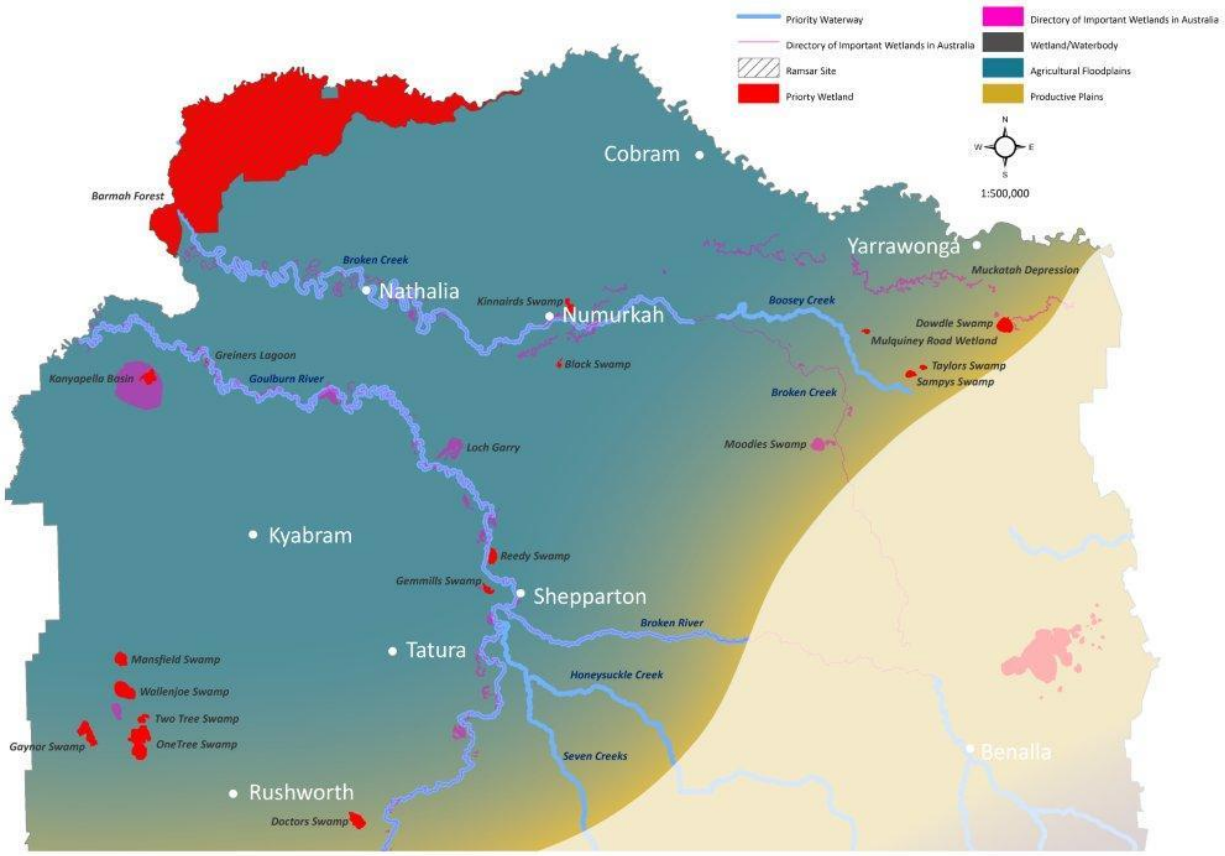


Figure 7.1 Agricultural Floodplains Priority Waterways.

Management Unit			Agriculture Floodplains		
Basin	**Goulburn**	Waterway	**Goulburn River**		
Values	Native Fish (2), Rip Veg Condition (4), Significant Amphibians (1) Significant Birds Riparian (2), Significant Birds Waterway (4), Significant EVCs (5), Significant Fish Migratory (1), Significant Fish Non Migratory (1), Significant Mammals (2), Camping (4), Game Hunting (5), Motor Boating (5), Non-Motor Boating (3), Recreational Fishing (5), Tracks (5), Landscape (0)			**Identification No**. 5-1, 5-2, 5-3, 5-4, 5-5	
Threats	Bank Instability (3), Change in Monthly Streamflow Variable (3), Increase in Low Flow Magnitude (5), Increase in Prop of Zero Flow (5), Invasive Fauna (Terrestrial) (5), Loss of Ins Habitat (Large Wood) (3), Red in High Flow Magnitude (4)			**State:** Sustainable Working	
Long-term Resource Condition	**1.** Stream hydrology will be improved by 2017 (5 reaches).				
	2 The riparian vegetation condition is maintained or improved by 2020.				
	3. Populations of native fish are maintained or improved by 2025				
	4. In stream habitat is maintained or improved by 2030				
	Management Outcome Targets		Management Activity/Output	Quantity	Lead agency/partner
AF.1	Environmental water program will target altered hydrology threat score	AF 1.1	Deliver water to river reach	Based on seasonal watering plan (See Chapter 4.2)	Water Corporation GB CMA
AF.2	Improved vegetation structure and diversity throughout reach	AF 2.1	Control invasive pest plant species	400 ha	Parks Vic, YYNAC joint management
		AF 2.2	Control pest animals (invasive species)	740 ha	Parks Vic, YYNAC joint management
		AF 2.3	Modify Agricultural practice change, Land use	480 ha	GB CMA, DEPI (region)
AF.3	Enhance recreational opportunities within reach	AF 3.1	Develop and Implement Recreational Strategy	1	GB CMA, Parks Vic, Local Government
AF.4	Increase bank stability and reduce erosion and sediment input	AF 4.1	Establish Earth works/ Armouring	0.3 km	GB CMA / PV YYNAC Joint management
AF.5	Increase in stream diversity, (Large Wood)	AF 5.1	Install Waterway structure, Large wood	5 km	GB CMA
	Estimated cost of activities for Goulburn River (5-1, 5-2, 5-3, 5-4 and 5-5)				$1,320,000
AF.6	Water Quality will be maintained or improved	AF 6.1	Deliver Farm Reuse recycle programs	240 No	CMA, Landholders
		AF 6.2	Provide fencing and revegetation incentives in Productive Plains and Commuting Hills (SES's)	100 km	CMA, Landholders
	Estimated cost of activities for Goulburn River (Water Quality: 5-1, 5-2, 5-3, 5-4 and 5-5)				$4,880,000
AF.7	Enhance floodplain to river linkages over 100 km of stream.	AF 7.1	Implement Lower Goulburn Floodplain management plan	3 reaches	GB CMA, Local Government, community
	Estimated cost of activities for Goulburn River (Floodplain reconnection: 5-1, 5-2, 5-3, 5-4 and 5-5)				$50,000,000
AF.8	Improvge community awareness of urban rivers and wetlands and encourage participation in their maintenance	AF 8.1	Deliver Riverconnect – Shepparton / Mooroopna	1	GB CMA, PV, COGS, YYNAC, education institutions
	Estimated cost of activities for Goulburn River (Riverconnect: 5-1, 5-2, 5-3, 5-4 and 5-5)				$400,000

Management Unit			Agriculture Floodplains			
Basin	**Broken**	Waterway	**Tullah Creek**			**Identification No.** 4 - 36
Values	Significant Birds Riparian (5), Significant Birds Waterway (5), Significant Fish Migratory (5), Significant Fish Non Migratory (5), within Ramsar Listed Wetland					
Threats	Bank Instability, Degraded Riparian Vegetation – Large Trees.					**State:** Ecological Healthy
Long-term Resource Condition	**1.** Stream bank condition will be maintained or improved by 2025.					
	2. Instream habitat condition will be maintained or improved by 2025.					
	3. The riparian vegetation condition is maintained or improved by 2025.					
	Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.9	Increase in bank stability where less than 25% of the reach has active bank erosion	AF 9.1	Waterway Stabilisation Strategy: Establish Earth works, Armouring		0.1 km	GB CMA / Parks Victoria
AF.10	Improve vegetation structure and diversity throughout the reach	AF 10.1	Establish Vegetation, Native indigenous		10 ha	GB CMA / Parks Victoria

Estimated cost of activities for Tullah Creek (4-36) (to be read in conjunction with Barmah Wetland)	$90,000

Management Unit			Agriculture Floodplains			
Basin	**Broken**	Waterway	**Boosey Creek**			**Identification No.** 4 - 32
Values	Significant Migratory Fish (5)					
Threats	Barriers to Fish Migration (5), Degraded Riparian Vegetation - Large Trees (4), Degraded Water Quality (5), Invasive Fauna (Aquatic) (5), Livestock Access (3), Loss of Ins Habitat (Large Wood) (3), Reduced Vegetation Width (3)					**State:** Sustainable Working
Long-term Resource Condition	**1.** Riparian bank condition will be maintained or improved by 2015.					
	2. Stream will be opened throughout for fish migration by 2021.					
	3. The riparian vegetation condition is maintained or improved by 2020.					
	Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF 11	Species control (livestock access) in over 25% of waterway frontages	AF 11.1	Implementation of riparian improvements (revegetation)		5 ha	GB CMA, landholders
		AF 11.2	Establish Management agreement, Binding non-perpetual		5 ha	GB CMA / Landholders / Landcare
		AF 11.3	Maintain Grazing regime, Exclusion		160 ha	GB CMA / Landholders / Landcare
		AF 11.4	Modify Agricultural practice change, Land use		160 ha	GB CMA / Landholders / Landcare
AF.12	Improved vegetation structure and diversity throughout reach	AF 12.1	Control invasive pest plant species		50 ha	GB CMA / Landholders / Landcare
		AF 12.2	Control pest animals (invasive species)		50 ha	GB CMA / Landholders / Landcare
AF.13	Increase the length of stream opened for fish passage	AF 13.1	Removal of in-stream fish barrier		1 site	GB CMA

Estimated cost of activities for Boosey Creek (4-32)	$237,500

Management Unit		Agriculture Floodplains			
Basin	**Broken**	Waterway	**Broken Creek**		**Identification No**. 4 - 21, 22, 23 and 24
Values	Significant Birds Waterway (5), Significant Fish Migratory (5) Significant Birds Waterway (4), Significant Reptiles Riparian (4) Camping (4), Motor Boating (4), Picnics and Barbecues (5), Recreational Fishing (5)				
Threats	Degraded Rip Veg - Large Trees (4), Invasive Fauna (Aquatic) (5), Invasive Fauna (Terrestrial) (5), Loss of Ins Habitat (Large Wood) (3)				**State:** Sustainable Working
Long-term Resource Condition	**1.** In stream Habitat will be maintained or improved by 2025.				
	2. Water Quality will be maintained or improved by 2050.				
	3. The riparian vegetation condition is maintained or improved by 2025.				
	4. Native fish community and structure will be maintained or improved by 2025				

	Management Outcome Targets		Management Activity/Output	Quantity	Lead agency/partner
AF 14	Reduce the impact of pest (fish) animals)	AF 14.1	Install Waterway structure, Carp screen	9 No	GB CMA / FV
AF.15	Species control (livestock access) in over 100% of waterway frontages	AF 15.1	Construction of riparian fence	2 km	GB CMA / Parks Victoria
		AF 15.2	Modify Agricultural practice change, Land use	480 ha	GB CMA / Parks Victoria / landowners
		AF 15.3	Establish Management agreement, Binding non-perpetual	2 ha	GB CMA / Parks Victoria
AF 16	Maintain and enhance in stream habitat diversity	AF 16.1	Install Waterway structure, Large wood	3 km	GBCMA
AF 17	Reduce the impact of pest plant and animal species	AF 17.1	Control invasive pest plant species	200 ha	Parks Vic / Landholders
		AF 17.2	Control pest animals (invasive species)	100 ha	Parks Vic /Landholders
AF.18	Environmental water program will target altered hydrology threat score	AF 18.1	Deliver water to river reach (4)	Based on seasonal watering plan (See Chapter 4.2)	Water Corporation GB CMA

Estimated cost of activities for Broken Creek (4-21, 22, 23 and 24)	$495,000

Management Unit			Agriculture Floodplains		
Basin	**Broken**	Waterway	**Broken River**		**Identification No**. 4 – 01
Values	Camping (4), Picnics and Barbecues (5), Sightseeing (5), Tracks (5)				
Threats	Bank Instability (4), Degraded Riparian Vegetation - Large Trees (3) Livestock Access (3)				**State:** Highly Modified
Long-term Resource Condition	1. Channel form will be maintained or improved by 2030.				
	2. The riparian/floodplain vegetation condition is maintained or improved by 2025.				
	3. Instream habitat (snags and migration opportunity) improved by 2025. (Link to 4.02).				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.19	Species control (livestock access) in over 50% of waterway frontages	AF 19.1	Construction of riparian fence	5 km	GB CMA / Parks Victoria
		AF 19.2	Remove Grazing regime, Continuous	5 ha	GB CMA / Parks Victoria / landowners
		AF 19.3	Establish Management agreement, Binding non-perpetual	5 ha	GB CMA / Parks Victoria
AF.20	Improve vegetation structure and diversity throughout reach.	AF 20.1	Establish Vegetation, Native indigenous	10 ha	
AF.21	Increase in habitat available with no waterway structures obstructing fish passage in this reach	AF 21.1	Remodel/remove Waterway structure, Fish barrier:	1 No	GB CMA G-MW

Estimated cost of activities for Broken River (4-01)	$1,692,000

Management Unit			Agriculture Floodplains		
Basin	**Goulburn**	Wetland	**Gaynors Swamp**	**Identification No**. 60118	
Values	Significant EVCs (4), Significant Flora Wetland (4), Significant Birds (5)				
Threats	Invasive Flora (5), Degraded Buffer (5)				
Long-term Resource Condition	1. Reduce the impact of invasive flora on wetland values				
	2 Maintain or enhance wetland buffer by 2030				
	3. Maintain or enhance bird habitats				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.22	Improve environmental water deliver and wetting regimes	AF22.1	Deliver Water regime, River reach	Based on seasonal watering plan (See Chapter 4.2)	GB CMA / PV / G-MW / VEWH
		AF22.1	Install Waterway structure, Flow regulator	2 No	GB CMA / PV / G-MW
AF.23	Improve condition of terrestrial habitat	AF23.1	Install Terrestrial habitat, Man-made ground feature	10 No	PV / GB CMA
		AF23.2	Establish Vegetation, Native indigenous	4 ha	
AF.24	Improved vegetation structure and diversity, control invasive flora	AF24.1	Establish Weed control, Non-woody	40 ha	
AF.25	Improve knowledge base / establish management plan	AF25.1	Establish Plan, Management Strategy	1 No	GB CMA / PV / G-MW
		AF25.2	Establish Publication, Online/printed:	1 No	

Estimated cost of activities for Gaynors Swamp	$ 1,122,000

Management Unit			Agriculture Floodplains		
Basin	**Goulburn**	Wetland	**Kaynapella Basin**	**Identification No.** 60205	
Values	Significant EVCs (4), Significant Flora Wetland (4)				
Threats	Invasive Fauna (Aquatic) (5), Invasive Fauna (Terrestrial) (5), Changed Water Regime (5), Degraded Buffer (5)				
Long-term Resource Condition	1. Reduce the threat of invasive species by 2031				
	2. Maintain or enhance the hydrologic regimes to the site by 2031				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.26	Improve environmental water deliver and wetting regimes	AF 26.1	Deliver Water regime, River reach	Based on seasonal watering plan (See Chapter 4.2)	GB CMA / PV / G-MW / VEWH
		AF 26.1	Waterway structure, Sill, Modify	1 No	
AF.27	Improve condition of terrestrial habitat	AF 27.1	Install Terrestrial habitat, Man-made ground feature	10 No	G-MW/PV /GB CMA / Landcare
		AF 27.2	Establish Vegetation, Native indigenous	10 ha	
		AF 27.3	Maintain Pest animal control, Terrestrial	400 ha	
AF.28	Maintain or improve water quality from adjacent lands	AF 28.1	Modify Agricultural practice change, Nutrient management	160 ha	GB CMA / DEPI (Ag Services) / G-MW
AF.29	Improved vegetation structure and diversity, control invasive flora	AF 29.1	Establish Weed control, Non-woody	400 ha	G-MW / PV / GB CMA
AF.30	Knowledge transfer	AF 30.1	Establish Publication, Online/printed:	1 No	

Estimated cost of activities for Kaynapella Basin	$575,000

Management Unit			Agriculture Floodplains		
Basin	**Goulburn**	Waterway	**Yambuna Bridge Rd (wetland)**	**Identification No.** 60240	
Values	Significant Birds (5)				
Threats	Invasive Fauna (Aquatic) (5), Invasive Fauna (Terrestrial) (5), Changed Water Regime (5)				
Long-term Resource Condition	1. Establish Management Plan by 2031				
	2. Reduce the threat of invasive species by 2031				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.31	Development of site management plan	AF 31.1	Modify Plan, Management Strategy,	1 No	GBCMA / Parks Vic
AF.32	Improved vegetation structure and diversity, control invasive flora	AF 32.1	Pest animal control, Terrestrial, Maintain	(included in Goulburn Reach 2)	

Estimated cost of activities for unnamed wetland (60240)	$50,000

Management Unit		Agriculture Floodplains			
Basin	**Goulburn**	Wetland	**Mansfield Swamp**	**Identification No**. 60265	
Values	Significant EVCs (4), Significant Flora Wetland (4), Significant Birds (5)				
Threats	Changed Water Regime (5), Degraded Buffer (5)				
Long-term Resource Condition	1. Enhance hydrologic / flow regime by 2021				
	2. Maintain or enhance condition of wetland buffer by 2031				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.33	Improve environmental water deliver and wetting regimes	AF 33.1	Deliver Water regime, River reach	Based on seasonal watering plan (See Chapter 4.2)	GB CMA / PV / G-MW / VEWH
		AF 33.2	Waterway structure, Sill, Modify	1 No	GB CMA / PV / G-MW
AF.34	Improve condition of terrestrial habitat	AF 34.1	Install Terrestrial habitat, Man-made ground feature	10 No	PV / GB CMA
		AF 34.2	Establish Vegetation, Native indigenous	10 ha	
AF.35	Maintain or improve water quality from adjacent lands	AF 35.1	Modify Agricultural practice change, Nutrient management	100 ha	GB CMA / G-MW
AF.36	Improved vegetation structure and diversity, control invasive flora	AF 36.1	Establish Weed control, Non-woody	250 ha	PV / GB CMA
AF.37	Knowledge transfer	AF 37.1	Establish Publication, Online/printed:	1 No	GB CMA / PV / G-MW

Estimated cost of activities for Mansfield Swamp	$780,000

Management Unit			Agriculture Floodplains		
Basin	**Broken**	Wetland	**Barmah Forest**	Identification No. 60706	
Values	Important Bird Habitats (5), Significant EVCs (5), Camping (4), Motor Boating (4), Non-Motor Boating (4), Picnics and Barbecues (5), Recreational Fishing (5), Sightseeing (5), Tracks (5), Significant Birds (5)				
Threats	Altered Hydrology Invasive Fauna, Invasive Fauna (Aquatic and Terrestrial)				
Long-term Resource Condition	1. Channel Hydrology will be maintained or improved by 2021.				
	2. The riparian/floodplain vegetation condition is maintained or improved by 2021.				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.38	Improved vegetation structure and diversity throughout reach	AF 38.1	Complete "Ecological Character" Plan	1	PV / GBCMA / DEPI (Region)
		AF 38.2	Control invasive pest plant species (aquatic): Maintain Weed control, Non-woody	1000 ha	GB CMA / Parks Victoria / YYNAC
		AF 38.3	Control pest animals (invasive species)	500 ha	
		AF 38.4	Control invasive pest plant species (terrestrial) Maintain Weed control, Woody:	1000 ha	
AF.39	Increase community knowledge of site and program of works (progress)	AF 39.1	Co-ordinate Engagement event, Conference / Field day	5 No	
AF.40	Environmental water program will target altered hydrology threat score	AF 40.1	Management of flow releases - Deliver water to river reach at required timing	Based on seasonal watering plan (See Chapter 4.2)	DEPI / GBCMA / FNSW / VEWH (CEWH/MDBA)

Estimated cost of activities for Barmah Wetland	$3,075,000

Management Unit			Agriculture Floodplains		
Basin	**Goulburn**	Wetland	**Doctors Swamp**	Identification No. 602010	
Values	Important Bird Habitats (5), Significant EVCs (5)				
Threats	Invasive Fauna (Aquatic) (5), Invasive Fauna (Terrestrial) (5), Degraded Buffer (4)				
Long-term Resource Condition	1. Maintain or enhance the status of bird habitat by 2021				
	2. Maintain or reduce the threat from invasive fauna and flora by 2031				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.40	Environmental water program will target altered hydrology threat score	AF 40.1	Management of flow releases - Deliver water to river reach at required timing	Based on seasonal watering plan (See Chapter 4.2)	GBCMA PV / G-MW / VEWH
AF.41	Improved vegetation structure and diversity throughout site	AF 41.1	Maintain Pest animal control, Terrestrial,	250 ha	PV / GBCMA
		AF 41.2	Establish Vegetation, Native indigenous,	10 ha	
AF.42	Knowledge transfer	AF 42.1	Establish Publication, Online/printed:	1 No	

Estimated cost of activities for Doctors Swamp	$110,000

Management Unit			Agriculture Floodplains		
Basin	**Goulburn**	Wetland	**Gemmills Swamp**	Identification No. 63156	
Values	Important Bird Habitats (5), Significant EVCs (5),				
Threats	Invasive Fauna (Aquatic) (5), Invasive Fauna (Terrestrial) (5), Changed Water Regime (5)				
Long-term Resource Condition	1. Reduce the threat of pest plant and animals by 2021				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.43	Improved vegetation structure and diversity throughout reach	AF 43.2	Control invasive pest plant species Maintain Weed control, Non-woody,	150 ha	Parks Victoria / GB CMA
		AF 43.3	Control pest animals (invasive species) Maintain Pest animal control, Terrestrial,	150 ha	

Estimated cost of activities for Gemmills Swamp	$105,000

Management Unit			Agriculture Floodplains		
Basin	**Broken**	Wetland	**Reedy Swamp Wildlife**	Identification No 63173	
Values	Important Bird Habitats (5), Significant Birds (5), Significant Amphibians (5)				
Threats	Invasive Fauna (Aquatic) (5), Invasive Fauna (Terrestrial) (5), Changed Water Regime (5),				
Long-term Resource Condition	1. Reduce the threat of invasive pest plant and animals by 2031				
	2. Maintain or improve the status of bird and bird habitats by 2031				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.44	Improved vegetation structure and diversity throughout reach	AF 44.1	Control pest animals (invasive species) Maintain Pest animal control, Terrestrial,	100 ha p.a.	Parks Victoria
AF.45	Environmental water program will target **altered** hydrology threat score	AF 45.1	Waterway structure, Flow regulator, Maintain	2 No	G-MW / GBCMA /
		AF 45.2	Management of flow releases - Deliver water to river reach at required timing	Based on seasonal watering plan (See Chapter 4.2)	GB CMA / G-MW / PV / VBEWH
AF.46	Enhance the management of surrounding catchment. Reduce nutrient impact on site	AF 46.1	Modify Agricultural practice change, Nutrient management		GB CMA / Local Government / Parks Vic
AF.47	Control nutrient inputs, Reduce nutrients at source of discharge water	AF 47.1	Water storage, Constructed wetland, Install	4	GB CMA / COGS

Estimated cost of activities for Reedy Swamp Wildlife Reserve	$770,000

Management Unit			Agriculture Floodplains		
Basin	**Broken**	Wetland	**Black Swamp**		Identification No. 63203
Values	Important Bird Habitats (5), Significant Birds (5)				
Threats	Invasive Fauna (Aquatic) (5), Invasive Fauna (Terrestrial) (5), Degraded Buffer (4)				
Long-term Resource Condition	1. Invasive fauna will be reduced by 2025				
	2. Wetland Buffer will be maintained or improved by 2030				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.48	Environmental water program will target altered hydrology threat score	AF 48.1	Management of flow releases - Deliver water to river reach at required timing	Based on seasonal watering plan (See Chapter 4.2)	GB CMA / G-MW / PV / VEWH
AF.49	Invasive species control (Carp access) in to site from adjacent waterway	AF 49.1	Control pest animals (invasive species) Modify Waterway structure, Carp screen,	1 No	GB CMA / Parks Victoria
AF.50	Improved vegetation structure and diversity throughout site	AF 50.1	Establish Vegetation, Native indigenous	5 ha	PV / GBCMA
		AF 50.2	Maintain Weed control, Non-woody	10 ha	
		AF 50.3	Maintain Pest animal control, Terrestrial	10 ha	

Estimated cost of activities for Black Swamp	$100,000

Management Unit			Agriculture Floodplains		
Basin	**Broken**	Wetland	**Kinnairds**		Identification No. 63206
Values	Significant Birds (4)				
Threats	Invasive Fauna (Aquatic) (5), Invasive Fauna (Terrestrial) (5), Changed Water Regime (5), Degraded Buffer (5)				State: TBA
Long-term Resource Condition	1. Maintain or enhance site for significant birds by 2021.				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.51	Improved vegetation structure and diversity throughout site	AF 51.1	Establish Vegetation, Native indigenous	12 ha	Moira Shire / G-MW /GBCMA
		AF 51.2	Maintain Weed control, Non-woody	20 ha	

Estimated cost of activities for unnamed wetland (63206)	$126,000

Management Unit			Agriculture Floodplains		
Basin	**Broken**	Wetland	**Sampys Swamp**	Identification No. 66906	
Values	Significant Birds (4)				
Threats	Invasive Fauna (Aquatic) (5), Invasive Fauna (Terrestrial) (5), Degraded Buffer (5)				
Long-term Resource Condition	1. Maintain or enhance site for significant birds by 2021.				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.52	Improved vegetation structure and diversity throughout site	AF 52.1	Establish Vegetation, Native indigenous	5 ha	GBCMA / Land managers
		AF 52.2	Maintain Pest animal control, Terrestrial	10 ha	

Estimated cost of activities for Sampys Swamp	$50,000

Management Unit			Agriculture Floodplains		
Basin	**Broken**	Wetland	**Taylors Swamp**	Identification No. 66911	
Values	Significant Birds (4)				
Threats	Invasive Fauna (Aquatic) (5), Invasive Fauna (Terrestrial) (5), Degraded Buffer (5)				
Long-term Resource Condition	1. Maintain or enhance site for significant birds by 2021.				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.53	Improved vegetation structure and diversity throughout site	AF 53.1	Establish Vegetation, Native indigenous	3 ha	PV / GBCMA
		AF 53.2	Maintain Pest animal control, Terrestrial	10 ha	

Estimated cost of activities for Taylors Swamp	$34,000

Management Unit			Agriculture Floodplains		
Basin	**Broken**	Wetland	**Mulquiney Rd (Wetland)**	Identification No. 67091	
Values	Significant Birds (4)				
Threats	Invasive Fauna (Aquatic) (5), Invasive Fauna (Terrestrial) (5), Invasive Flora (Wetland) (5), Changed Water Regime (3), Degraded Buffer (5), Soil Disturbance (5)				
Long-term Resource Condition	1. Maintain or enhance site for significant birds by 2021.				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
AF.54	Protect site from influence of stock	AF 54.1	Maintain Fence, Fence	1 km	GBCMA / Land managers
AF.55	Improved vegetation structure and diversity throughout site	AF 55.1	Establish Vegetation, Native indigenous	3 ha	
		AF 55.2	Maintain Weed control, Non-woody	10 ha	
AF.56	Management Plan	AF 56.1	Plan, Management Strategy, Establish	1 No	GB CMA

Estimated cost of activities for unnamed wetland (67091)	$139,000

7.3 PRODUCTIVE PLAINS

Waterways in this region are the open plains and are the outfall from the Strathbogie Ranges and other surrounding hills. Waterways in this area are largely unregulated, except for the Goulburn River. These waterways are considered to be in moderate condition. Major threats to waterways include European Carp, degraded riparian, through grazing pressure, poor in stream habitat and water harvesting in the upper catchments.

Priority waterway assets are:

Goulburn River: A Heritage River associated with wetlands of national significance which supports threatened species including Murray Cod, Silver Perch and Macquarie Perch. The Goulburn River floodplain contains cultural heritage sites and provides water for agriculture, urban centres and recreational use.

Gobarup Creek: Associated with wetlands of national significance.

Hughes Creek and Seven Creeks: Supports the threatened Macquarie Perch and Murray Cod.

Broken River: Associated with wetlands of national significance and supports the threatened Murray Cod, Macquarie Perch and Silver Perch.

Holland Creek: Supports the threatened Macquarie Perch.

Boosey Creek: Significant populations of reptile and amphibians.

Wetlands within the Productive Plains are generally in a moderate to good state. Priority wetland assets are:

Doctors Swamp (Bioregional): One of the most intact River Red Gum swamps in Victoria which supports a diverse number of species including 73 wetland flora species and 44 wetland fauna species.

Winton Wetlands (Bioregional): The wetland complex provides important habitat for a large number of waterbird species including the migratory Lathams Snipe and maintains seven nationally threatened flora species.

Tahbilk Lagoon (Bioregional): A large billabong connected to the Goulburn River. The wetland is a biological hot spot that maintains a number of threatened species including the Broad-shelled Turtle, the most southerly remnant freshwater Catfish population and the largest known Watershield (native waterlily) population in Victoria.

Moodies Swamp (DIWA listed): A large Cane Grass wetland that provides important habitat for waterbirds including the threatened Brolga and Eastern Great Egret. It maintains the nationally threatened Rigid Water Milfoil

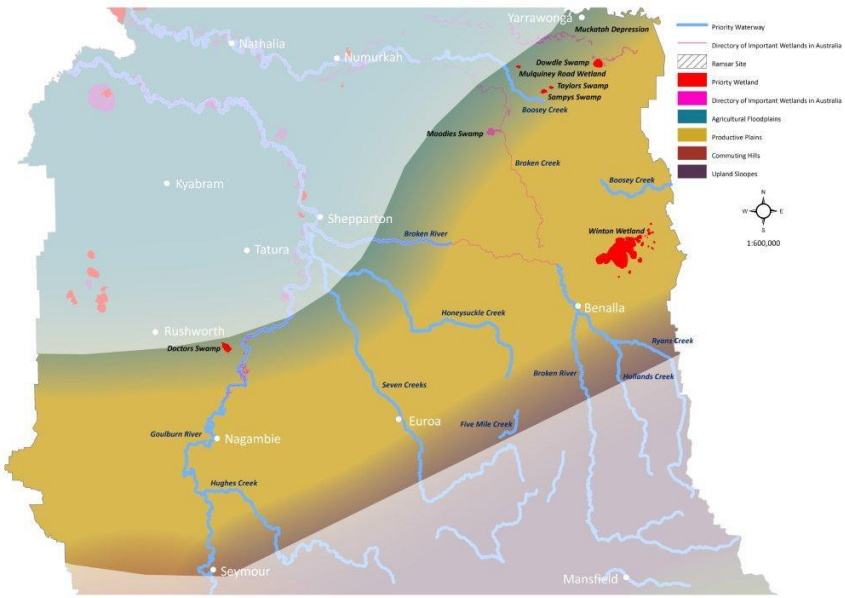


Figure 7.2 Productive Plains Priority Waterways

Management Unit			Productive Plains		
Basin	**Broken**	Waterway	**Hollands Creek**	Identification No. 4 - 13	
Values	Significant Fish Migratory (5)				
Threats	Bank Instability (5), Barriers to Fish Migration (4), Degraded Riparian Vegetation - Large Trees (3), Degraded Water Quality (5), Livestock Access (3), Reduced Vegetation Width (3)			State: Sustainable Working	
Long-term Resource Condition	1. The riparian/floodplain vegetation condition is maintained or improved by 2021.				
	2. In stream diversity is maintained or improved by 2030				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
PP.1	Species control (livestock access) in over 50% of waterway frontages	PP 1.1	Construction of riparian fence	2 km	GB CMA / Landcare / land holders
		PP 1.2	Grazing regime, Continuous: Remove	4 ha	GB CMA / Landcare / land holders
		PP 1.3	Establish Management agreement, Binding non-perpetual	4 ha	
		PP 1.4	Establish Agricultural practice change, Biomass retained	160 ha	
PP.2	Increase in habitat availability within in stream zone	PP 2.1	Install Waterway structure, Large wood	1 km	GB CMA
PP.3	Improved vegetation structure and diversity throughout reach	PP 3.1	Supplementary planting of mixed vegetation	4 ha	GB CMA / Landcare
PP.4	Increase in habitat available with no waterway structures obstructing fish passage in this reach	PP 4.1	Install Waterway structure, Fishway	1	

Estimated cost of activities for Hollands Creek (4-13)	$212,000

Management Unit		Productive Plains			
Basin	**Goulburn**	Wetland	**Goulburn River**		Identification No. 5-08 / 5-07 / 5-06
Values	Native Fish (2), Rip Veg Condition (4), Significant Birds Waterway (4), Significant EVCs (5), Significant Fish Migratory (5), Significant Fish Non Migratory (5), Camping (4), Game Hunting (5), Motor Boating (5), Non-Motor Boating (3), Recreational Fishing (5), Sightseeing (5), Swimming (5)				
Threats	Altered Streamflow Seasonality (3), Bank Instability (5), Increase in Low Flow Magnitude (5), Increase in Prop of Zero Flow (5), Invasive Fauna (Terrestrial) (5), Loss of Ins Habitat (Large Wood) (4), Red in High Flow Magnitude (4)				State: Sustainable Working
Long-term Resource Condition	1. The riparian/floodplain vegetation condition is maintained or improved by 2021.				
	2. In stream diversity is maintained or improved by 2030				
	3. Hydrology within the Goulburn River is improved, to sustain current values, by 2021				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency /partner
PP.5	Environmental water program will target altered hydrology threat score	PP 5.1	Management of flow releases - Deliver water to river reach at required timing	Based on seasonal watering plan (See Chapter 4.3)	DEPI / GBCMA
PP.6	Species control (livestock access) in over 50% of waterway frontages	PP 6.2	Establish Grazing regime, Continuous	10 km	GB CMA / Landcare / land owners
		PP 6.3	Establish Management agreement, Binding non-perpetual	10 ha	
PP.7	Increase in habitat availability within in stream zone	PP 7.1	Install Waterway structure, Large wood	3 km	GB CMA
PP.8	Improved vegetation structure and diversity throughout reach	PP 8.1	Control invasive pest plant species, Maintain Weed Control Woody	200	Parks Vic
		PP 8.2	Control pest animals (invasive species)	30 ha	Parks Vic
PP.9	Increase bank stability within zones of active bank erosion	PP 9.1	Establish Earth works, Armouring	0.1	GB CMA

Estimated cost of activities for Goulburn River (5-6, 7, and 8)	$525,000

Management Unit			Productive Plains		
Basin	**Goulburn**		Wetland	**Goulburn River**	Identification No. 5-10 /5-09
Values	Native Fish (2), Rip Veg Condition (4), Significant Birds Waterway (4), Significant EVCs (5), Significant Fish Migratory (5), Significant Fish Non Migratory (5), Camping (4), Game Hunting (5), Motor Boating (5), Non-Motor Boating (3), Recreational Fishing (5), Sightseeing (5), Swimming (5)				
Threats	Altered Stream flow Seasonality (3), Bank Instability (5), Increase in Low Flow Magnitude (5), Increase in Prop of Zero Flow (5), Invasive Fauna (Terrestrial) (5), Loss of Ins Habitat (Large Wood) (4), Red in High Flow Magnitude (4)				State: Sustainable Working
Long-term Resource Condition	1. The riparian/floodplain vegetation condition is maintained or improved by 2021.				
	2. In stream diversity is maintained or improved by 2030				
	3. Hydrology within the Goulburn River is improved, to sustain current values, by 2021				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
PP.10	Environmental water program will target altered hydrology threat score	PP 10.1	Management of flow releases - Deliver water to river reach at required timing	Based on seasonal watering plan (See Chapter 4.3)	DEPI / GBCMA
PP.11	Species control (livestock access) in over 50% of waterway frontages	PP 11.1	Construction of riparian fence	5 km	GB CMA / Landcare / land holders
		PP 11.2	Grazing regime, Continuous: Remove	15 ha	GB CMA / Landcare / land holders
		PP 11.3	Establish Management agreement, Binding non-perpetual	15 ha	
		PP 11.4	Establish Agricultural practice change, Biomass retained	160 ha	
PP.12	Increase in habitat availability within in stream zone	PP 12.1	Install Waterway structure, Large wood	1	GB CMA
PP.13	Improved vegetation structure and diversity throughout reach	PP 13.1	Control invasive pest plant species, Establish Weed Control, Woody	100 ha	GB CMA / Landcare
		PP 13.2	Control pest animals (invasive species)	20	Landcare / landholders
PP.14	Increase bank stability within zones of active bank erosion	PP 14.1	Establish Earth works, Armouring	0.1	GB CMA

Estimated cost of activities for Goulburn River (9 and 10)	$415,000

Management Unit	Productive Plains				
Basin	**Goulburn**	Waterway	**Hughes Creek**		Identification No. 5-39 /5-38
Values	Significant Fish Non Migratory (5)				
Threats	Livestock Access (5), Loss of Ins Habitat (Large Wood) (3), Loss of Ins Habitat (Sedimentation) (3), Reduced Vegetation Width (3)				State: Sustainable Working
Long-term Resource Condition	**1.** The riparian/floodplain vegetation condition is maintained or improved by 2021.				
	2. Sediment input is reduced from current levels and stabilized by 2035				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
PP.15	Species control (livestock access) in over 25% of waterway frontages	PP 15.1	Construction of riparian fence	5 km	GB CMA / Landcare / land owners
		PP 15.2	Grazing regime, Continuous: Remove	10 ha	
		PP 15.3	Establish Management agreement, Binding non-perpetual	10 ha	
PP.16	Increase in habitat availability within in stream zone	PP 16.1	Install Waterway structure, Large wood	2 km	GB CMA
PP.17	Facilitate fish movement within and to adjacent reaches	PP 17.1	Modify Waterway Structure, Fishway	1 No	GB CMA
Estimated cost of activities for Hughes Creek (5-37)				$230,000	

Management Unit	Productive Plains				
Basin	**Goulburn**	Waterway	**Hughes Creek**		Identification No. 5-38 /5-39
Values	Significant Fish Non Migratory (5)				
Threats	Livestock Access (5), Loss of Ins Habitat (Large Wood) (3), Loss of Ins Habitat (Sedimentation) (3), Reduced Vegetation Width (3)				State: Sustainable Working
Long-term Resource Condition	**1.** The population of Macquarie perch is secure, increases or remains stable in numbers and/or distribution, and continues to produce young.				
	2. The population of Trout cod is established, and population remains stable in numbers and/or distribution by 2035				
	3. The riparian/floodplain vegetation condition is maintained or improved by 2021.				
	4. Sediment input is reduced from current levels and stabilized by 2035				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
PP.18	Species control (livestock access) in over 25% of waterway frontages	PP 18.1	Construction of riparian fence	20 km	GB CMA / Landcare / land owners
		PP 18.2	Grazing regime, Continuous: Remove	40 ha	
		PP 18.3	Establish Management agreement, Binding non-perpetual	40 ha	
PP.19	Increase in habitat availability within in stream zone	PP 19.1	Install Waterway structure, Large wood	3 km	GB CMA
PP.20	Maintenance and management of sediment input from key tributary streams	PP 20.2	Install Waterway Structure, Stabilisation of tributary streams	10 No	GB CMA
PP.21	Maintenance and management of sediment input from key tributary streams	PP 21.1	Investigate the sources and fates of sediments	1 No	GB CMA
PP.22	Improved vegetation structure and diversity throughout reach	PP 22.1	Establish Vegetation, Native indigenous	20 ha	GB CMA / Landcare
PP.23	Monitor population and distribution of Macquarie perch	PP 23.1	Monitoring Plan	1 No	GB CMA
Estimated cost of activities for Hughes Creek (5-38 / 5-39)				**$1,190,000**	

Management Unit			Productive Plains		
Basin	**Goulburn**		Wetland	**Seven Creeks**	Identification No. 5 – 17 / 5-18
Values	Significant Fish Migratory (5), Significant Fish Non Migratory (5)				
Threats	Bank Instability (4), Barriers to Fish Migration (4), Degraded Rip Veg - Large Trees (3), Livestock Access (3), Loss of Ins Habitat (Large Wood) (3), Reduced Vegetation Width (3)				State: Sustainable Working
Long-term Resource Condition	1. The riparian/floodplain vegetation condition is maintained or improved by 2021.				
	2 Hydrology sub-index is maintained or improved by 2021				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
PP.24	Species control (livestock access) in over 25% of waterway frontages	PP 24.1	Construction of riparian fence	7 km	GB CMA / Landcare / land owners
		PP 24.2	Grazing regime, Continuous: Remove	14 ha	
		PP 24.3	Establish Management agreement, Binding non-perpetual	14 ha	
PP.25	Increase in habitat availability within in stream zone	PP 25.1	Install Waterway structure, Large wood	2 km	GB CMA
PP.26	Improved vegetation structure and diversity throughout reach	PP 26.1	Establish Vegetation, Native indigenous	10 ha	GB CMA / Landcare
PP.27	Maintain channel stability	PP 27.1	Establish Earth works, Armouring,	0.2	GB CMA
PP.28	Increase in habitat available with no waterway structures obstructing fish passage in this reach	PP 28.1	Modify waterway structures, Fishway	5	GB CMA

Estimated cost of activities for Seven Creeks (5-17, 5-18)	$540,000

Management Unit			Productive Plains		
Basin	**Goulburn**	Wetland	**Seven Creeks**	Identification No. 5-19 / 5 -20	
Values	Significant Fish Migratory (5), Significant Fish Non Migratory (5)				
Threats	Bank Instability (4), Barriers to Fish Migration (4), Degraded Rip Veg - Large Trees (3), Livestock Access (3), Loss of Ins Habitat (Large Wood) (3), Reduced Vegetation Width (3)			State: Sustainable Working	
Long-term Resource Condition	1. The population of Trout cod is secure, remains stable in numbers and their distribution is expanded				
	2. The riparian/floodplain vegetation condition is maintained or improved by 2021.				
	3. Hydrology sub-index is maintained or improved by 2021				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
PP.29	Species control (livestock access) in over 25% of waterway frontages	PP 29.1	Construction of riparian fence	10 km	GB CMA / Landcare / land holders
		PP 29.2	Grazing regime, Continuous: Remove	20 ha	GB CMA / Landcare / land holders
		PP 29.3	Establish Management agreement, Binding non-perpetual	20 ha	
PP.30	Increase in habitat availability within in stream zone	PP 30.1	Install Waterway structure, Large wood	1 km	GB CMA
PP.31	Monitor population and distribution of Trout cod and Macquarie perch	PP 31.1	Monitoring Plan	1 No	GB CMA
PP.32	Improving our knowledge on stream flow / groundwater interactions.	PP 32.1	Investigate links between groundwater and channel hydrology	1 No	G-MW

Estimated cost of activities for Seven Creeks (5-19, 5-20)	$550,000

Management Unit			Productive Plains		
Basin	**Broken**	Waterway	**Boosey Creek**	Identification No. 4 - 34	
Values	Significant Amphibians (5), Significant Reptiles Riparian (5)				
Threats	Degraded Riparian Vegetation - Large Trees (4), Invasive Fauna (Terrestrial) (5)., Livestock Access (3), Loss of Ins Habitat (Large Wood) (3), Reduced Vegetation Width (3)			State: Highly Modified	
Long-term Resource Condition	1. The riparian condition is maintained or improved by 2030				
	2. In stream habitat is improved in priority zones by 2030				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
PP.33	Species control (livestock access) in over 25% of waterway frontages	PP 33.1	Construction of riparian fence	2 km	GB CMA / Landcare / land holders
		PP 33.2	Grazing regime, Continuous: Remove	4 ha	
		PP 33.3	Establish Management agreement, Binding non-perpetual	4 ha	
PP.34	Improved vegetation structure and diversity throughout reach	PP 34.1	Establish Vegetation, Native indigenous	4 ha	
		PP 34.2	Establish Pest animal control, Terrestrial	10 ha	

Estimated cost of activities for Boosey Creek (4-34)	$97,000

Management Unit			Productive Plains		
Basin	**Broken**	Waterway	**Broken River**		Identification No. 4-03
Values	Significant Birds Riparian (5), Significant Birds Waterway (4), Significant Fish Migratory (5), Significant Mammals (4)				
Threats	Barriers to Fish Migration (4), Degraded Riparian Vegetation - Large Trees (3), Degraded Water Quality (5), Invasive Fauna (Terrestrial) (5), Invasive Flora (Aquatic) (3), Livestock Access (3), Loss of Ins Habitat (Large Wood) (3), Reduced Vegetation Width (3)				State: Sustainable Working
Long-term Resource Condition	1. Channel Hydrology will be maintained or improved by 2015.				
	2. The riparian/floodplain vegetation condition is maintained or improved by 2025.				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
PP.35	Species control (livestock access) in over 25% of waterway frontages	PP 35.1	Construction of riparian fence	5 km	GB CMA / Landcare / land holders
		PP 35.2	Grazing regime, Continuous: Remove	10 ha	
		PP 35.3	Establish Management agreement, Binding non-perpetual	10 ha	
		PP 35.4	Establish Agricultural practice change, Biomass retained	160 ha	
PP.36	Increase in habitat availability within in stream zone	PP 36.1	Install Waterway structure, Large wood	1 km	GB CMA
PP.37	Increase in habitat available with no waterway structures obstructing fish passage in this reach	PP 37.1	Install Waterway structure, Fishway	1 No	GB CMA FV / Fishers
PP.38	Improved vegetation structure and diversity throughout reach	PP 38.1	Establish Vegetation, Native indigenous	10 ha	GB CMA / Landcare
		PP 38.2	Establish Pest animal control, Terrestrial	20 ha	Landcare / landowners
		PP 38.3	Maintain Weed control, Non-woody	10 ha	GB CMA / G-MW
			Maintain Weed Control, Woody	5 ha	Landcare / landowners

Estimated cost of activities for Broken River (4-03)	$2,805,000

Management Unit			Productive Plains		
Basin	**Broken**	Wetland	**Winton Wetland Complex**		Identification No. 4~20~WS1
Values	Important Bird Habitats (-), Significant EVCs (-), Recreational Fishing (-), Sightseeing (5), Tracks (5), Significant Birds (-)				
Threats	Invasive Fauna, Invasive Fauna (Aquatic and Terrestrial), Water Quality				
Long-term Resource Condition	1. Support the Winton Wetland Rehabilitation				
	2. The wetland vegetation condition is maintained or improved by 2021.				
	3. The wetland condition is maintained or improved by 2025.				

Management Outcome Targets		Management Activity/Output	Quantity	Lead agency/partner
PP.39	Return to Wetland	Support the Winton Wetland recovery initiative		Winton Wetland Committee of Management / GB CMA

Estimated cost of activities for Winton Wetland Complex (4~20~WS1)	$0

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
PP.40	Improved vegetation structure and diversity throughout reach	PP40.1	Control invasive pest plant species	400 ha	Parks Vic, YYNAC joint management
		PP40..2	Control pest animals (invasive species)	400 ha	Parks Vic, YYNAC joint management
		PP40.3	Modify Agricultural practice change, Land use	480 ha	GB CMA, DEPI (region)
PP.41	Species control (livestock access) in over 25% of waterway frontages	PP 41.1	Implementation of riparian improvements (revegetation)	15 ha	GB CMA, landholders
		PP 41.2	Establish Management agreement, Binding non-perpetual	15 ha	GB CMA / Landholders / Landcare
		PP 41.3	Establsih Grazing regime, Exclusion	50 ha	GB CMA / Landholders / Landcare

Estimated cost of activities for Winton Wetland Complex (4~20~WS1) – Catchment Program	$4.637,500

Management Unit			Productive Plains		
Basin	**Broken**		Wetland	**Dowdle Swamp**	Identification No. 67905
Values	Significant Birds (5)				
Threats	Invasive Fauna (Aquatic) (5), Invasive Fauna (Terrestrial) (5), Changed Water Regime (5), Degraded Buffer (5)				
Long-term Resource Condition	1. The location and habitat for aquatic birds will be maintained or improved by 2015.				
	2. The wetland condition is maintained or improved by 2021.				
	3. Buffer condition in maintained or improved by 2030				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
PP.40	Improved vegetation structure and diversity throughout	PP 40.1	Control pest animals (invasive species) Maintain Pest animal control, Terrestrial,	10 ha	PV / GB CMA / Landcare
		PP 40.2	Control invasive pest plant species Maintain Weed control, Non-woody,	10 ha	
PP.41	Improve the quality of water produced from within catchment	PP 41.1	Establish Vegetation, Native indigenous, Buffer	10 ha	
PP.42	Maintain flow regulation (as designed) at outfall.	PP 42.2	Maintain Waterway Structure; Flow regulator		PV / GB CMA / G-MW

Estimated cost of activities for Dowdle Swamp (67905)	$ 115,000

7.4 UPLAND SLOPES

The Upland Slopes generate the largest proportion of the Catchment's total water yield. Lake Eildon, which regulates the Goulburn River, is an important feature and contributes to agriculture and lifestyles in this area. The Goulburn River delivers a regulated supply of high quality water down the Catchment. Waterways vary in their condition, with the Goulburn River considered to be in a poor state, largely due to regulation. Streams in the upland slopes are highly valued for recreation and tourism.

Major threats to water quality in this area include erosion, sediment and residue from recent bushfires. There are also a number of point sources of pollution (including township and lifestyle development).

Changes to flow and flood regimes that regulate rivers threaten native fish populations and floodplain dependent plant species. However this regulation also provides many values to the community, in terms of visitation, recreation and productive intensive farming.

Priority waterway assets are:

Goulburn River: a Heritage River that supports threatened species. It contains important cultural heritage sites, provides water for agriculture and urban townships, and supports recreational activities such as fishing and boating.

Hughes Creek and Hollands Creek: support the threatened Macquarie Perch.

Seven Creek: support the Trout cod.

Broken River: supports Macquarie Perch population, and is utilised for recreational fishing and provides water four stock and domestic use.

Wetlands here are considered to be generally in a moderate state. Maintaining and enhancing wetland connectivity is important in the valleys. Key wetlands wetland assets include:

Central Highlands Peatlands (DIWA listed): Five separate sphagnum moss dominated bogs located along rivers and gullies in the Central Highlands.

Yea Wetlands (Regional): Maintains the nationally and internationally threatened Hemiphlebia Damselfly (living fossil).

Horseshoe Lagoon (Bioregional): A billabong on the mid-Goulburn River which is one of only a few wetlands in the region in excellent condition.

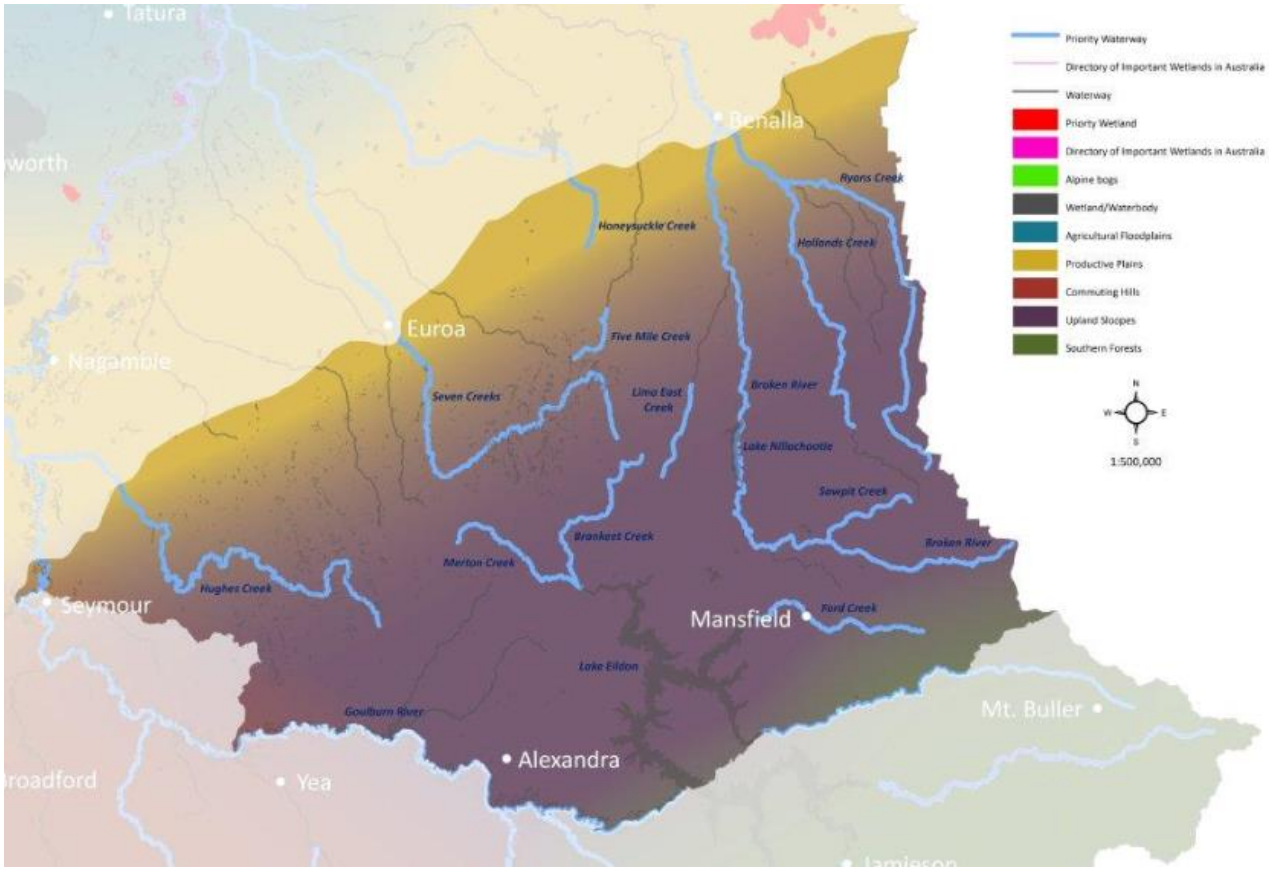


Figure 7.3 Upland Slopes Priority Waterways

Management Unit			Upland Slopes		
Basin	**Broken**	Waterway	**Hollands Creek**		Identification No. 4-14
Values	Significant Fish Migratory (5)				
Threats	Bank Instability (4), Barriers to Fish Migration (4), Livestock Access (3), Reduced Vegetation Width (3)				State: Sustainable Working
Long-term Resource Condition	1. The population of Macquarie perch is secure and continues to produce young				
	2. The riparian vegetation condition is maintained or improved by 2030				
	3. Barriers to the movement of migratory species is removed/remodeled by 2021				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
US.1	Species control (livestock access) in over 25% of waterway frontages	US 1.1	Construction of riparian fence	5 km	GB CMA / Landcare / land holders
		US 1.2	Grazing regime, Continuous: Remove	5 ha	
		US 1.3	Establish Management agreement, Binding non-perpetual	5 ha	
US.2	Increase bed and bank stability at sites of active bank erosion	US 2.1	Establish Earth works, Armouring	0.1	GB CMA
US.3	Increase in habitat availability – modify waterway structures obstructing fish passage	US 3.1	Modify Waterway structure, Fishway	2	GB CMA
US.4	Assessment of fish populations	US 4.1	Assessment of Macquarie perch (population and distribution)	1	GB CMA / DEPI (ARI)

Estimated cost of activities for Hollands Creek (4-14)	$300,000

Management Unit			Upland Slopes		
Basin	**Goulburn**	Waterway	**Acheron River**		Identification No. 5-62
Values	Aqua Invert Community Condition (5), Riparian Vegetation Condition (4)				
Threats	Livestock Access (5), Loss of Ins Habitat (Large Wood) (4)				State: Ecologically Healthy
Long-term Resource Condition	1. Maintain "Ecological Healthy Status"				
	2. In stream habitat status will be maintained or improved by 2030				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
US.5	Increase in habitat availability within in stream zone	US 5.1	Install Waterway structure, Large wood	1 km	GB CMA
US.6	Species control (livestock access) in over 25% of waterway frontages	US 6.1	Construction of riparian fence	4 km	GB CMA / Landcare / land holders
		US 6.2	Grazing regime, Continuous: Remove	8 ha	
		US 6.3	Establish Management agreement, Binding non-perpetual	8 ha	
		US 6.4	Establish Agricultural practice change, Biomass retained	50 ha	

Estimated cost of activities for Acheron River (5-62)	$160,000

Management Unit			Upland Slopes		
Basin	**Broken**	Waterway	**Broken River**		Identification No. 4-05 / 4-06
Values	Urban or Rural Township Water Sources (4), Water Storages (4), Significant Fish Migratory (5)				
Threats	Invasive Flora (Riparian) - Tree Layer (3), Livestock Access (3), Loss of Ins Habitat (Large Wood) (5), Reduced Riparian Connectivity (5), Reduced Vegetation Width (5)				State: Sustainable Working
Long-term Resource Condition	1. Riparian Zone will be maintained or improved by 2040				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
US.7	Species control (livestock access) in over 25% of waterway frontages	US 7.1	Construction of riparian fence	5 km	GB CMA / Landcare / land holders
		US 7.2	Grazing regime, Continuous: Remove	10 ha	
		US 7.3	Establish Management agreement, Binding non-perpetual	10 ha	
		US 7.4	Establish Agricultural practice change, Biomass retained	50 ha	
US.8	Improved vegetation structure and diversity throughout reach	US 8.1	Establish Weed control, Woody	10 ha	GB CMA
US.9	Increase in habitat availability within in stream zone	US 9.1	Install Waterway structure, Large wood	1 km	GB CMA

Estimated cost of activities for Broken River (4-05 / 4-06)	$240,000

Management Unit			Upland Slopes		
Basin	**Goulburn**	Waterway	**Goulburn River**		Identification No. 5-13 / 5-14
Values	Native Fish (2), Rip Veg Condition (3), Significant Amphibians (1), Significant Birds Riparian (4), Significant Birds Waterway (4), Significant EVCs (5), Non-Motor Boating (3), Recreational Fishing (5), Landscape (3)				
Threats	Bank Instability (3), Invasive Fauna (Terrestrial) (5), Invasive Flora (Riparian), Tree Layer (3), Livestock Access (5), Loss of In stream Habitat (Large Wood) (5), Loss of In stream Habitat (Sedimentation) (4), Reduced Vegetation Width (3)				State: Sustainable Working
Long-term Resource Condition	1. Heritage River values will be maintained or improved.				
	2. Riparian Zone will be maintained or improved by 2021				
	3. Recreational fishing / recreational general will be maintained or improved by 2021				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
US.10	Species control (livestock access) in over 25% of waterway frontages	US 10.1	Construction of riparian fence	5 km	GB CMA / Landcare / land owners
		US 10.2	Grazing regime, Continuous: Remove	10 ha	
		US 10.3	Establish Management agreement, Binding non-perpetual	10 ha	
US.11	Improved vegetation structure and diversity throughout reach	US 11.1	Establish Weed control, Woody	10 ha	GB CMA
US.12	Improve the in stream sub-index (Large Woody Debris)	US 12.1	Install Waterway structure, Large wood	1 km	
US.13	Increase bank stability at zones with active bank erosion (mainstream and tributary)	US 13.1	Establish Earth works, Armouring	0.2 km	GB CMA
		US 13.2	Establish Vegetation, Native indigenous,	5 ha	GB CMA / Landcare / landholders
		US 13.3	Install Waterway structure, Chute,	4 km	GB CMA
		US 13.4	Establish Pest animal control, Terrestrial,	50 ha	Landcare / land holders

Estimated cost of activities for Goulburn River (5-13 / 5-14)	$705,000

Management Unit						Upland Slopes	
Basin		**Goulburn**		Waterway	**Brankeet Creek / Merton Creek**		Identification No. 5-74 / 5-75
Values	Urban or Rural Township Water Sources (4)						
Threats	Livestock Access (3) Bank Instability (3), Livestock Access (3), Reduced Vegetation Width (3)						State: Sustainable Working
Long-term Resource Condition	1. Riparian Zone will be maintained or improved by 2031						
Management Outcome Targets			Management Activity/Output			Quantity	Lead agency/partner
US.14	Species control (livestock access) in over 25% of waterway frontages		US 14.1	Construction of riparian fence		4 km	GB CMA / Landcare / land owners
			US 14.2	Grazing regime, Continuous: Remove		8 ha	
			US 14.3	Establish Management agreement, Binding non-perpetual		8 ha	
			US 14.4	Establish Agricultural practice change, Biomass retained		50 ha	
US.15	Increase bank stability at zones with active bank erosion (mainstream and tributary)		US 15.1	Establish Earth works, Armouring		0.1 km	GB CMA
			US 15.2	Establish Vegetation, Native indigenous,		8 ha	GB CMA / Landcare / landholders

Estimated cost of activities for Brankeet / Merton system (5-74 / 5-75)	$194,000

Management Unit						Upland Slopes	
Basin		**Broken**		Waterway	**Broken River**		Identification No. 4-04
Values	Significant Fish Migratory (5), Significant Fish Non Migratory (5)						
Threats	Barriers to Fish Migration (4), Increase in Low Flow Magnitude (3), Loss of In-stream Habitat (Large Wood) (3)						State: Sustainable Working
Long-term Resource Condition	1. Hydrology sub-index will be maintained or improved by 2021 2. In-stream habitat will be maintained or improved by 2030 3. Migratory and non-migratory fish communities will be maintained or improved by 2030						
Management Outcome Targets			Management Activity/Output			Quantity	Lead agency/partner
US.16	Environmental water improving the flow magnitude threat score		US 16.1	Deliver Water regime, River reach		Based on seasonal watering plan (See Chapter 4.3)	GB CMA / G-MW
US.17	Increase in habitat available - address waterway structures obstructing fish passage in this reach		US 17.1	Investigate Waterway structure, Fishway		1	GB CMA
US.18	Improve the in stream sub-index (Large Woody Debris)		US 18.1	Install Waterway structure, Large wood		2 km	GB CMA

Estimated cost of activities for Broken River (4-04)	$180,000

Management Unit			Upland Slopes		
Basin	**Broken**	Waterway	**Lima East Creek**		Identification No. 4-10
Values	Aqua Invert Community Condition (5), Riparian Vegetation Condition (5)				
Threats	Invasive Fauna (Terrestrial) (5)				State: Ecologically Healthy
Long-term Resource Condition	1. Ecologically Healthy status will be maintained				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
US.19	Improved vegetation structure and diversity throughout reach	US 19.1	Establish Pest animal control, Terrestrial	50 ha	GBCMA / Landholder
		AF 19.2	Undertake regular assessments of condition and presence of invasive pest plant species	50 ha	GB CMA / Landholder

Estimated cost of activities for Lima East Creek (4-10)	$35,000

Management Unit			Upland Slopes		
Basin	**Broken**	Waterway	**Ryans Creek**		Identification No. 4-17 / 4-16
Values	Urban or Rural Township Water Sources (4), Water Storages (3), Significant Amphibians (5), Significant Birds Riparian (4), Significant Birds Waterway (4) Significant Fish Non Migratory (5) Significant Amphibians (5), Significant Birds Riparian (4), Significant Birds Waterway (4), Significant Fish Non Migratory (5)				
Threats	Invasive Fauna (Terrestrial) (5), Loss of Ins Habitat (Large Wood) (4) Invasive Fauna (Terrestrial) (5), Livestock Access (3), Reduced Vegetation Width (3)				State: Ecologically Healthy
Long-term Resource Condition	1. Maintain "Ecological Healthy" status.				
	2. The riparian vegetation condition is maintained or improved by 2021.				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
US.20	Improved vegetation structure and diversity throughout reach	US 20.1	Establish Pest animal control, Terrestrial	1	Forests/ landholders / GBCMA
US.21	Species control (livestock access) in over 25% of waterway frontages	US 21.1	Construction of riparian fence	4 km	GB CMA / Landcare / land owners
		US 21.2	Grazing regime, Continuous: Remove	8 ha	
		US 21.3	Establish Management agreement, Binding non-perpetual	8 ha	

Estimated cost of activities for Ryans Creek (4-16 / 4-17)	$155,000

Management Unit				Upland Slopes	
Basin	**Broken**	Waterway	**Sawpit Gully and Bridge Creek**	Identification No. 4-11	
Values	Urban or Rural Township Water Sources (4),				
Threats	Bed Instability (Degradation) (3), Livestock Access (3)			State: Sustainable Working	
Long-term Resource Condition	1. Riparian zone will be maintained or improved by 2031				
	2. Water quality will be maintained or improved by 2031				
	3. Channel form will be maintained or improved by 2031				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
US.22	Species control (livestock access) in over 25% of waterway frontages	US 22.1	Construction of riparian fence	10 km	GB CMA / Landcare / land owners
		US 22.2	Grazing regime, Continuous: Remove	20 ha	
		US 22.3	Establish Management agreement, Binding non-perpetual	20 ha	
		US 22.4	Establish Agricultural practice change, Biomass retained	160 ha	
US.23	Increase in bed and bank stability within the reaches with active bank erosion	US 23.1	Modify and install waterway structure (pile fields / chutes) / Establish Earthworks, Armouring	4 km	

Estimated cost of activities for Sawpit Gully Bridge Creek system (4-11)	$290,000

7.5 COMMUTING HILLS

The remaining extent of forest contributes to healthy river ecosystems, which ideally provide constant yields of filtered high quality water down the Catchment.

Threats to waterways here relate largely to run off and water quality.

Waterways are classified as being in good condition, however, as with soil health, fires affect water yield and quality. Water quality is under threat in this region from invasive species in waterways, including European Carp. Priority waterway assets are:

Goulburn River: a Heritage River that support high community values (including tourism, recreation and aesthetics.

King Parrot Creek and Yea River: Supports populations of the threatened Macquarie Perch.

Acheron River: Environmental Site of Significance.

Taggerty River: Contains ecologically healthy and representative reaches and supports the threatened *Barred galaxias*.

Mollisons Creek and Sunday Creek – supply of water supplies for urban, Stock and Domestic

Figure 7.4 Commuting Hills Priority Waterways

Management Unit			Commuting Hills		
Basin	**Goulburn**	Waterway	**Mollisons Creek**		Identification No. 5-42 / 5-43
Values	Urban or Rural Township Water Sources (4), Water Storages (3)				
Threats	Degraded Water Quality (5), Livestock Access (5), Reduced Vegetation Width (3)				State: Sustainable Working
Long-term Resource Condition	1. Enhance vegetation width on mainstream by 2050				
	2. Reduce the impact of stock by 2030				
	3. Maintain or enhance water quality by 2050				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
CH.1	Species control (livestock access) in over 50% of waterway frontages	CH 1.1	Construction of riparian fence	15 km	GB CMA / Landcare / land holders
		CH 1.2	Grazing regime, Continuous: Remove	30 ha	
		CH 1.3	Establish Management agreement, Binding non-perpetual	30 ha	
		CH 1.4	Establish Agricultural practice change, Biomass retained	160 ha	
CH.2	Improve vegetation structure and diversity throughout reach.	CH 2.1	Establish Vegetation, Native indigenous	5 ha	

Estimated cost of activities for Mollisons Creek (5-42 / 5-43)	$545,000

Management Unit			Commuting Hills		
Basin	**Goulburn**	Waterway	**King Parrot Creek**	Identification No. 5-51	
Values	Significant Fish Migratory (5)				
Threats	Livestock Access (5), Loss of Ins Habitat (Large Wood) (3), Reduced Vegetation Width (3)			State: Sustainable Working	
Long-term Resource Condition	1. The population of Macquarie perch is secure, increases or remains stable in numbers and/or distribution, and continues to produce young.				
	2. The riparian/floodplain vegetation condition is maintained or improved by 2021.				
	3. In stream diversity is maintained or improved by 2030				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
CH.3	Species control (livestock access) in over 50% of waterway frontages	CH 3.1	Construction of riparian fence	5 km	GB CMA / Landcare / landholders
		CH 3.2	Grazing regime, Continuous: Remove	10 ha	
		CH 3.3	Establish Management agreement, Binding non-perpetual	10 ha	
CH.4	Increase in habitat availability within in stream zone	CH 4.1	Install Waterway structure, Large wood	1 km	GB CMA
CH.5	Improved vegetation structure and diversity throughout reach	CH 5.1	Control invasive pest plant species	40 ha	GB CMA / Landcare / landholders
CH.6	Monitor population and distribution of Macquarie perch	CH 6.1	Monitoring Plan	1 No	GB CMA, DEPI (ARI)

Estimated cost of activities for King Parrot Creek (5-51)	$650,000

Management Unit	Commuting Hills		
Basin	**Goulburn**	Waterway	**Yea River**
Values	Significant Fish Migratory (5)		Identification No. 5-55 and 5 - 56
Threats	Barriers to Fish Migration (3), Livestock Access (5), Loss of Ins Habitat (Large Wood) (5) Reduced Vegetation Width (3)		State: Sustainable Working

Long-term Resource Condition	
	1. The population of Macquarie perch is secure, increases or remains stable in numbers and/or distribution, and continues to produce young.
	2. The riparian/floodplain vegetation condition is maintained or improved by 2021.
	3. In stream diversity is maintained or improved by 2030

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
CH.7	Species control (livestock access) in over 50% of waterway frontages	CH 7.1	Construction of riparian fence	10 km	GB CMA / Landcare / land owners
		CH 7.2	Grazing regime, Continuous: Remove	20 ha	
		CH 7.3	Establish Management agreement, Binding non-perpetual	20 ha	
CH.8	Increase in habitat availability within in stream zone	CH 8.1	Install Waterway structure, Large wood	1 km	GB CMA
		CH 8.2	Investigate the management of high sediment sources and fates.	1 No	GB CMA
CH.9	Improved vegetation structure and diversity throughout reach	CH 9.1	Supplementary planting of mixed vegetation	15 ha	GB CMA / Landcare
		CH 9.2	Control invasive pest plant species	40 ha	GB CMA, DEPI (PLS)
CH.10	Monitor population and distribution of Macquarie perch	CH 10.1	Monitoring Plan	1 No	GB CMA, DEPI (ARI)

Estimated cost of activities for Yea River (5-55 / 5-56)	$1,070,000

Management Unit	Commuting Hills				
Basin	**Goulburn**	Waterway	**Goulburn River**		Identification No. 5 – 12 / 5 - 11
Values	Native Fish (2), Rip Veg Condition (3), Significant Amphibians (1), Significant Birds Riparian (4), Significant Birds Waterway (4), Significant EVCs (5), Significant Fish Migratory (1), Significant Mammals (1), Non-Motor Boating (3), Landscape (3)				
Threats	Invasive Fauna (Terrestrial) (5), Invasive Flora (Riparian) - Tree Layer (3), Livestock Access (5), Loss of Ins Habitat (Large Wood) (4), Loss of Ins Habitat (Sedimentation) (4), Reduction in High Flow Magnitude (3), Reduced Vegetation Width (4)				State: Highly Modified
Long-term Resource Condition	1. Channel Hydrology will be maintained or improved by 2025.				
	2. The riparian/floodplain vegetation condition is maintained or improved by 2025.				
	3. Heritage River Values are maintained or improved by 2025.				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
CH.11	Species control (livestock access) in over 40% of waterway frontages	CH 11.1	Construction of riparian fence	10 km	GB CMA / Landcare /landholders
		CH 11.2	Grazing regime, Continuous: Remove	20 ha	
		CH 11.3	Establish Management agreement, Binding non-perpetual	20 ha	
		CH 11.4	Establish Agricultural practice change, Biomass retained	320 ha	
CH.12	Increase in habitat availability within in stream zone	CH 12.1	Install Waterway structure, Large wood	2 km	GB CMA
		CH 12.2	Investigate the management of high sediment sources and fates.	1 No	GB CMA
CH.13	Improved vegetation structure and diversity throughout reach	CH 13.1	Supplementary planting of mixed vegetation	5 ha	GB CMA / DEPI (PLS) / landholders
		CH 13.2	Control invasive pest plant species	20 ha	
		CH 13.3	Control pest animals (invasive species)	100 ha	
CH.14	Environmental water program will target altered hydrology threat score	CH 14.1	Deliver Water regime, River reach: Management of flow releases - Deliver water to river reach at required timing	Based on seasonal watering plan	DEPI / GBCMA / PNSW

Estimated cost of activities for Goulburn River (5-11 / 5-12)	$1,250,000

Management Unit			Commuting Hills		
Basin	**Goulburn**	Waterway	**Sunday Creek**	Identification No. 5 - 47	
Values	Urban or Rural Township Water Sources (4), Significant Fish Non Migratory (5)				
Threats	Degraded Water Quality (5), Livestock Access (1)			State: Sustainable Working	
Long-term Resource Condition	1. Maintain or reduce the access to key waterways from stock by 2025				
	2. Water Quality is maintained or improved by 2030.				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
CH.15	Species control (livestock access) in over 40% of waterway frontages	CH 15.1	Establish Agricultural practice change, Biomass retained	50 ha	GB CMA / local government / landholders
		CH 15.2	Establish Management agreement, Binding non-perpetual,	50 ha	

Estimated cost of activities for Sunday Creek (5-47)	$50,000

7.6 SOUTHERN FORESTS

The Southern Forests contribute to healthy river ecosystems, providing constant yields of filtered high quality water. Waterways in this region are considered to be in a good to excellent state.

There are several significant native fish species in this area.

Increasing numbers of tracks for timber extraction and recreational activities intensifies erosion, resulting in reduced water quality. This results in increased sedimentation of waterways, destruction of fish habitat and changes to stream condition.

Priority waterways assets are:

Goulburn River: a Heritage River that is an ecologically healthy reach. Its tributaries support threatened species (Spotted Tree Frog and Alpine Bent).

Rubicon River: a priority river with near "Ecologically Healthy" status, supports Barred galaxies in tributary streams – Keppel Hut Creek, Pheasant Creek, Perkins Creek, Taggerty River, Torbreck River and Stanleys Creek.

Big River: a Heritage River and representative reaches that supports the threatened Spotted Tree Frog.

Howqua River: A Heritage River that has high economic values in the form of tourism and recreation.

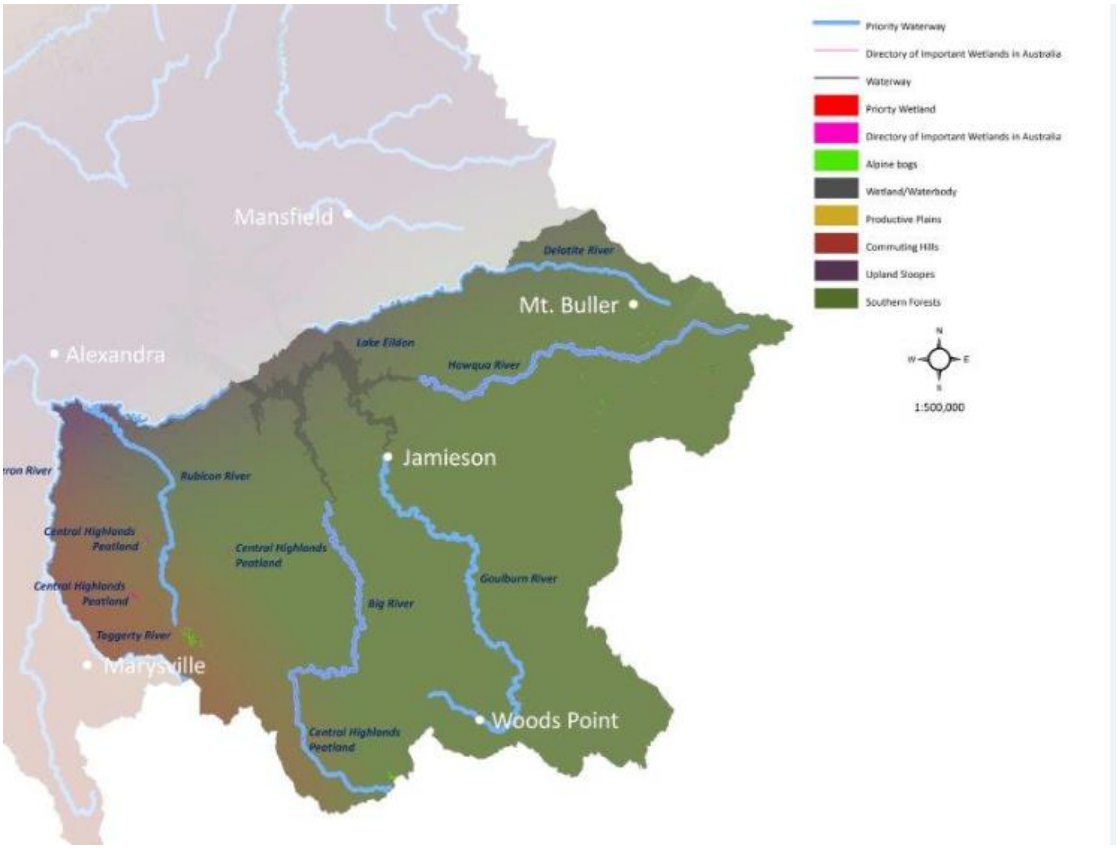
Other priority waterways include: **Delatite River, Taggerty River and Acheron River.**

The current condition of wetlands is considered to be good. The major threats to wetlands are pest plant and animal invasion and soil erosion. Priority wetland assets are:

Alpine bogs (National significance): areas that maintains the nationally endangered Alpine Sphagnum Bogs and associated fens ecological community.

Central Highlands Peatlands (DIWA listed): Five separate sphagnum moss dominated bogs located along rivers and gullies in the Central Highlands.

Figure 7.5 Southern Forests Priority Waterways



Management Unit			Southern Forests		
Basin	**Goulburn**	Wetland	**Rubicon River**		Identification No. 5-65 / 5-66
Values	Aquatic Invert Community Condition (5), Riparian Vegetation Condition (3), Significant Fish Non Migratory (5)				
Threats	Livestock Access (5), Loss of In stream Habitat (Large Wood) (4), Reduced Vegetation Width (3)				State: Ecologically Healthy
Long-term Resource Condition	1. The riparian vegetation condition is maintained or improved by 2021 (R65)				
	2. In stream habitat is maintained or improved by 2030 (R65)				
	3. Maintain the Ecologically Healthy status (R66)				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
SF.1	Species control (livestock access) in over 25% of waterway frontages	SF 1.1	Construction of riparian fence	2 km	GB CMA / Landcare / land holders
		SF 1.2	Grazing regime, Continuous: Remove	4 ha	
		SF 1.3	Establish Management agreement, Binding non-perpetual	4 ha	
SF.2	Increase in habitat availability within in stream zone	SF 2.1	Install Waterway structure, Large wood	0.5	GB CMA
SF.3	Improved vegetation structure and diversity throughout reach	SF 3.1	Establish Vegetation, Native indigenous	4 ha	GB CMA / Landcare / land holders
		SF 3.2	Establish Woody Weed Control	2 ha	GB CMA / land managers

Estimated cost of activities for Rubicon River (5-65 / 5-66)	$152,000

Management Unit			Southern Forests		
Basin	**Goulburn**	Wetland	**Big River**		Identification No. 5-67 / 5-68
Values	Urban or Rural Township Water Sources (4), Riparian Vegetation Condition (5) Significant Amphibians (5), Non-Motor Boating (5), Recreational Fishing (5) Landscape (3), Aqua Invert Community Condition (5)				
Threats	Invasive Fauna (Terrestrial) (5)				State: Ecologically Healthy
Long-term Resource Condition	1. The health/condition of the Big River is maintained				

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
SF.4	Improved vegetation structure and diversity throughout reach	SF 4.1	Control pest animals (invasive species)	100 ha	Forest Managers / GBCMA
SF.5	Monitor the condition (Ecological Healthy)	SF 5.1	Monitoring Plan: Assessment of Invasive Species	1 No	

Estimated cost of activities for Big River (5-67 / 5-68)	$70,000

Management Unit	Southern Forests		
Basin	**Goulburn**	Waterway	**Howqua River**
Values	Urban or Rural Township Water Sources (4), Aqua Invertebrate Community Condition (5), Riparian Vegetation Condition (4), Significant Amphibians (4), Non-Motor Boating (4), Recreational Fishing (5)		Identification No. 5-69 /5-70
Threats	Invasive Fauna (Terrestrial) (5), Livestock Access (3)		State: Ecologically Healthy
Long-term Resource Condition	1. The riparian/floodplain vegetation condition is maintained or improved by 2025		
	2. Recreational Values are maintained or improved by 2025.		

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
SF.6	Species control (livestock access) in over 25% of waterway frontages	SF 6.1	Construction of riparian fence	2 km	GB CMA / Landcare / land owners
		SF 6.2	Grazing regime, Continuous: Remove	4 ha	
		SF 6.3	Establish Management agreement, Binding non-perpetual	4 ha	
SF.7	Improved vegetation structure and diversity throughout reach	SF 7.1	Establish Vegetation, Native indigenous		GB CMA / Landcare
SF.8	Improved vegetation structure and diversity throughout reach	SF 8.1	Control pest animals (invasive species)	100 ha	GB CMA / landholders
		SF 8.2	Weed control, Woody, Establish	10 ha	GB CMA / landholders
		SF 8.3	Establish Assessment, Invasive species	100 ha	GB CMA

Estimated cost of activities for Howqua River (5-69 / 5-70)	$140,000

Management Unit					Southern Forests	
Basin	**Goulburn River**		Waterway	**Goulburn River**		Identification No. 5-15 / 5-16
Values	Urban or Rural Township Water Sources (4), Water Storages (5), Aqua Invert Community Condition (5), Rip Veg Condition (4), Significant Fish Migratory (5), Camping (4), Game Hunting (5), Non-Motor Boating (4), Recreational Fishing (5), Sightseeing (5)					
Threats	Invasive Fauna (Terrestrial) (5), Invasive Flora (Riparian) - Shrub Layer (4)					State: Ecologically Healthy
Long-term Resource Condition	1. Channel Hydrology will be maintained or improved by 2021.					
	2. The riparian/floodplain vegetation condition is maintained or improved by 2021.					
	3. Heritage Values (social, economic, cultural and environmental) will be maintained or improved by 2025					
Management Outcome Targets			Management Activity/Output		Quantity	Lead agency/partner
SF.9	Improved vegetation structure and diversity throughout reach	SF 9.1	Control invasive pest plant species / Weed control, Woody		5 ha	GBCMA / PV / PLS / Forests / Local Government
		SF 9.2	Control pest animals (invasive species)		200 ha	
		SF 9.3	Establish Assessment, Invasive species		200 ha	

Estimated cost of activities for Goulburn River (5-15 / 5-16)	$325,000

Management Unit	Southern Forests			
Basin	**Goulburn River**	Waterway	**Delatite River**	Identification No. 5-71 / 5-72
Values	Urban or Rural Township Water Sources (4), Significant Fish Migratory (5), Riparian Vegetation Condition (4)			
Threats	Barriers to Fish Migration (3), Invasive Flora (Riparian) - Tree Layer (3), Livestock Access (3), Loss of Ins Habitat (Large Wood) (5), Reduced Vegetation Width (3) Invasive Fauna (Terrestrial) (5)			State: Sustainable Working
Long-term Resource Condition	1. Water Quality in maintained or improved by 2030			
	2. Riparian sub-index is maintained or improved by 2030			
	3. Recreational (social) values are maintained or improved by 2030			

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
SF.10	Species control (livestock access) in over 25% of waterway frontages	SF 10.1	Construction of riparian fence	5 km	GB CMA / Landcare / land owners
		SF 10.2	Grazing regime, Continuous: Remove	10 ha	
		SF 10.3	Establish Management agreement, Binding non-perpetual	10 ha	
SF.11	Improved vegetation structure and diversity throughout reach	SF 11.1	Establish Vegetation, Native indigenous	5 ha	GB CMA / Landcare / land manager
			Establish Pest animal control, Terrestrial	50 ha	
			Establish Assessment, Invasive species	1 No	
SF.12	Improved vegetation structure and diversity throughout reach	SF 12.1	Control pest plants (invasive species) Establish Weed control, Woody	10 ha	GB CMA
SF.13	Increase habitat available with no waterway structures obstructing fish passage in this reach	SF 13.1	Install Waterway structure, Fishway	1 No	GB CMA
SF.14	Increase in habitat availability within in stream zone	SF 14.1	Install Waterway structure, Large wood	2 km	GB CMA

Estimated cost of activities for Delatite River (5-71 /5-72)	$ 640,000

Management Unit	Southern Forests			
Basin	**Goulburn River**	Waterway	**Taggerty River**	Identification No. 5-64
Values	Aqua Invert Community Condition (5), Riparian Vegetation Condition (4)			
Threats	Loss of Ins Habitat (Large Wood) (3)			State: Ecologically Healthy
Long-term Resource Condition	1. Maintain "Ecological Healthy Status"			
	2. In stream habitat status will be maintained or improved by 2030			

Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
SF.15			Monitor status and condition		

Estimated cost of activities for Taggerty River (5-64)	$ (see maintenance)

Management Unit			Southern Forests		
Basin	**Goulburn River**	Waterway	**Acheron River**		Identification No. 5-63
Values	Aqua Invert Community Condition (5), Riparian Vegetation Condition (5)				
Threats	Loss of Ins Habitat (Large Wood) (3)				State: Ecologically Healthy
Long-term Resource Condition	1. Maintain "Ecological Healthy Status"				
	2. In stream habitat status will be maintained or improved by 2030				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
SF.16		Monitor status and condition			
Estimated cost of activities for Acheron River (5-63)				$ (see maintenance)	

Management Unit			Southern Forests		
Basin	**Goulburn**	Wetland	**Central Highland Peatlands**		Identification No. CHP
Long-term Resource Condition	1. The condition of the Central Highland Peatlands is maintained or improved				
Management Outcome Targets		Management Activity/Output		Quantity	Lead agency/partner
SF.17	Improved vegetation structure and diversity throughout reach	SF 17.1	Control pest plants (invasive species) Establish Weed control, Woody	500 ha	DEPI (Region) / Forest Managers / GB CMA / TCAC
SF.18	Monitor the condition (Ecological Healthy)	SF 18.1	Monitoring Plan: Assessment of Invasive Species	1 No	
Estimated cost of activities for Central Highland Peatlands				**$** 1,000,000	

7.7 URBAN CENTRES

Historically our urban areas and satellite townships were built near or in a close proximity to waterways and wetlands. Waterways were a focal point for development due to the need for water, food and recreation.

Waterways in urban areas provide a range of environmental, social and economic values (Table 7.1). Urban areas also present a threat to some of the values we associate with waterways and wetlands. (Table 7.1)

Table 7.1 – Values and Threats within Urban Waterways

Values	Threats (direct)
Social	Channel Modification
Recreational Fishing	Removal of LWD
Non-Motor Boating	Development
Motor Boating	Water discharge
Camping	Waste discharge
Swimming	Removal / Modification of Native Vegetation
Walking, Hiking, Cycling	Litter
Sightseeing	Weeds
Picnics/ Barbecues	
Pre-European (Indigenous)	
Post-European Landscape	
Community Groups	
Economic	
Urban/Rural Township Water Sources	
Wastewater Discharges	

7.7.1 MANAGEMENT ARRANGEMENTS

For the urban sections of waterways and wetlands within the Goulburn Broken region (DSE 2012) the catchment management authorities (CMAs), and in some areas, local government councils, are the waterway managers. Strategic planning documents that influence the management of waterways in regional urban areas include:

- **Regional Waterway Strategies** (to be developed): Management actions to improve the condition of priority waterways in urban areas will be identified in regional Waterway Strategies (see Chapter 4).
- **Regional Floodplain Management Strategies**: CMAs are also responsible for floodplain management and have previously developed Regional Floodplain Management Strategies.
- **Local stormwater plan**: Local councils are responsible for managing stormwater and drainage infrastructure in the urban areas. In undertaking waterway management actions in regional urban areas, CMAs have previously relied on strong partnerships, cost-sharing arrangements and good will from local government and other partners.
- **Urban Waterway plans:** In partnership with the community some local governments together with the local Catchment Management Authority have developed a management plan for urban waterways (see below)

7.7.2 URBAN WATERWAYS IN THE REGION

Throughout the Goulburn Broken region a number of townships surround or run parallel to key waterway systems.

Township and waterway interface creates a separate set of circumstances with respect of waterway management, social and economic values are heightened and direct threats imposed on waterway vales are increased.

Waterways within the region aligned with waterways are shown in Table 7.2.

RiverConnect

More and more Shepparton and Mooroopna residents are enjoying their stunning riverine environment because of the RiverConnect project.

RiverConnect links the goodwill and energy of many and varied groups and individuals, enhancing existing activities and creating the opportunity to develop bigger, whole of community projects.

People from vastly different backgrounds are interacting through educational, recreational, artistic, cultural heritage and environmental activities.

RiverConnect resulted from a ground swell in understanding that the time had come to embrace the Goulburn and Broken Rivers and the opportunities they present. The RiverConnnect vision is for the riverine environment to be the heart and soul of Shepparton and Mooroopna.

Education, Aboriginal Participation, Land Management, and Communication Working Groups of RiverConnect involve more people in implementing detailed actions listed in the RiverConnect Strategic Plan, which was prepared in 2011 after extensive community consultation.

Eighteen of the nineteen schools in the RiverConnect area have adopted a-reach and thousands of students participate in activities on the banks of the Goulburn and Broken Rivers each year.

7.7.3 ISSUES

A number of key threats are present within Urban Waterways, these are materialised under the following key issues:

- Stormwater Management
- Recreation and Open Space Planning
- Water Reuse Planning and Implementation

Waterways in urban centres have been highly modified to accommodate development and built infrastructure. Water is extracted from the rivers for consumptive use, and waste and storm water is also discharged, following treatment. Waste water is treated prior to discharge, but often stormwater is not.

Waterways are a major feature of urban centres but are under stress from numerous threats associated with high density living, such as gross and diffuse pollutants, flood mitigation works that change flows, water weeds and European Carp, which all reduce the quality of water.

Pollutants change the chemistry of water which in turn effects fish and the food on which they rely.

7.7.4 ACTION AND RECOMMENDED STRATEGIES

Waterways in urban areas;

- The MAV strongly supports consultation with local government on the action to investigate incentives for local government and household interventions to retain, use and infiltrate urban stormwater runoff through capital works programs. The MAV understands current issues around the regulatory uncertainty of stormwater ownership are to be considered through the review of the *Water Act 1989.* Therefore, this should be considered as part of the implementation of this action, as well as greater information about the economic rationalisation of various stormwater reuse projects, including maintenance costs.
- The MAV supports the extension of water performance standards to other types of development in Victoria. However, Clause 56.07 of the Victorian Planning Provisions which currently applies to residential subdivisions is not without its challenges and requires review before being transposed to other types of development.
- This Strategy does not help to improve the management of domestic onsite waste systems, which largely rests on the shoulders of local government. Domestic wastewater management has been a significant issue for councils recently and the role of councils in onsite domestic wastewater management in open potable water

supply catchments in particular. The obligations of local government in domestic wastewater management are likely to intensify, with new potable guidelines expected to be released shortly by the Victorian Government. These guidelines will increase the requirements of councils in domestic wastewater management planning and this should be reflected in the Strategy.

- The MAV strongly believes that Strategy is an opportunity to improve the integration of agencies involved in domestic wastewater management for improved water quality outcomes, rather than repeating what the legislated roles already are.

Table 7.2: Urban Centres, Waterway Reach, SES band Existing Management Plans

Township	Social Ecological System	Waterway	Existing Management Plans
Shepparton Mooroopna	Agricultural Floodplain	Goulburn River	Urban Land Use Study Shepparton-Mooroopna Stormwater Quality Strategy prepared for The City of Greater Shepparton - February 1999
Shepparton	Agricultural Floodplain	Broken River	
Benalla	Productive Plain	Broken River	Lake Benalla Riverine Trail and Waterway Management Plan Stormwater Strategy for Benalla Rural City
Murchison	Productive Plain	Goulburn River	
Nagambie	Productive Plain	Lake Nagambie	Land and On-Water Management Plan 2012
Seymour	Commuting Hills	Goulburn River	Stormwater Strategy for Mitchell Shire
Nathalia	Agricultural Floodplain	Broken Creek	Stormwater Strategy for Moira Shire Council
Numurkah	Agricultural Floodplain	Broken Creek	
Katamatite	Agricultural Floodplain	Broken Creek	
Tungamah	Productive Plain	Boosey Creek	Boosey Creek Management Plan
Avenel	Productive Plain	Hughes Creek	
Broadford	Commuting Hills	Sunday Creek	
Broadford	Commuting Hills	Dry Creek	
Kilmore	Commuting Hills	Kilmore Creek	
Yea	Commuting Hills	Yea River	
Molesworth / Thornton	Commuting Hills	Goulburn River	

Priority management activities is presented below

ACTION: Encourage and support local government in the development and implementation of Urban waterway plans

Responsibility: GB CMA, Local Government, Community Interest Groups Timeframe 2013 - 2021

ACTION: Provide protection to urban waterways in planning schemes

Responsibility: Local Government Timeframe 2013 - 2021

ACTION Support urban Waterway Community Actions and Activities

Responsibility: Local Government / GB CMA / Community Timeframe 2013 - 2021

7.8 ASSUMPTIONS

The Assumptions underpinning the link between Implementation Targets and Management Outcomes is derived from:

- conceptual models (from GHD, 2011) which that will provide consistent assumptions about the relationships between values and threats and the management activities required to reduce threats to values.
- evidence used to determine the confidence rating for association values. (from Doeg, 2009) between values and threats
- assumptions developed by the Authority over the life of the previous River Health Strategy (see Table 7.3)

Table 7.3 – Outputs Assumptions and Outcomes.

Implementation Strategy	Assumption	Outcomes	Link to KPI's
Environmental Water			
Waterways with negotiated environmental flow regimes	Increase the Hydrology ISC rating. Influence in stream habitat and aquatic life.	Number of river reaches with improved environmental flow regimes	**Number of river reaches and wetlands with water managed to meet environmental objectives** No or reaches with water improved floodplain connectivity
Management of the Riparian Zone			
Kilometres of riparian land subject to weed management	Improve riparian flora and fauna diversity Promote the regeneration of native species; Protect significant riparian flora and fauna species; Promote aquatic biodiversity and habitat; Improve water quality, particularly dissolved oxygen and temperature;	Additional area and length of habitat improved – riparian	**ha managed for pest plant and animals**
Management of the Riparian Zone	Improve Streamside Zone ISC rating over 50% of the length of reach under management Improve water quality, particularly nutrients, by providing a buffer to filter nutrient input to streams and wetlands. Specifically: reduce total phosphorous inputs by 2.5-6.5 kg/km/yr	Additional area and length of habitat improved – riparian Estimated reduction in phosphorous. Estimated reduction in sediment	**km of riparian fencing / hectares of fenced wetlands** **ha covered by management agreements (Number of management agreements)**
Replanting of indigenous vegetation (ha)	Maintain Streamside Zone ISC rating in 50% of reaches under management over the period of the Strategy		**ha of indigenous revegetation**
Weed suppression and control (aquatic)	Improve riparian flora and fauna diversity, promote the regeneration of native species	Improve riparian flora and fauna diversity, promote the regeneration of native species	**km managed for pest plant and animals**

Management of the channel			
Modify Barriers	Improve native fish community values within all stream reaches upstream of the barrier to the next barrier in the system.	Additional length of fish passage provided	**km opened for native fish passage**
Sites subject to bed and bank stabilisation	Maintain Physical Form ISC rating Reduce sediment mobilisation from the banks. Specifically: reduce fine and coarse sediment mobilisation from bank profile by 60-612 t/km/yr and reduce total phosphorous inputs by 15-153 kg/km/yr.	Estimated reduction in phosphorous. Estimated reduction in sediment	**km treated for soil erosion**
No of sites with improved in stream habitat		Length of in stream habitat improved	**km of in-stream habitat established**
Works on Waterways			**Number of permits processed and planning referrals received**
Water Quality / Savings			
No. of reaches with water quality improvements		Estimated reduction in phosphorous, sediments etc,	**No or reaches with water quality improvements**
Other			
No. of plans developed for Rivers and Creeks of high social value		Additional area and number of NRM group action plans developed and being implemented	
No. reaches with community programs / engagement initiatives	Increase regional community understanding and knowledge about river health issues;		**Completion of the Regional Strategy for Healthy Rivers and Wetlands**
	Encourage greater community involvement in river management and restoration		**Number of community groups supported**
Monitoring			**Number of sites monitored for asset condition**

7.9 OUTCOMES BY SES / LANDSCAPE

The prevous Chapter sets out the high level (20 year) goals for waterways in the region for each priority waterway, together with Management Targets and Management Activity. Table 7.4 presents high level outcomes by Social Ecological System / Landscape.

Table 7.4 Outcomes (by Social Ecological System)

Social – Ecological Systems	km of in-stream habitat established	km opened for native fish passage	km of riparian fencing	hectares of fenced wetlands	ha of indigenous revegetation	ha managed for pest plant and animals	km treated for soil erosion	Number of river reaches and wetlands with water managed to meet environmental objectives	Number of sites monitored for asset condition	Number of community groups supported	ha covered by management agreements (Number of management agreements)	Number of permits processed and planning referrals received	Completion of the Regional Strategy for Healthy Rivers and Wetlands	Ecological Monitoring Projects	Local Waterway Health Strategy/Management or Recovery Plan	**No or reaches with water quality improvements**	**No or reaches with water improved floodplain connectivity**
	KPI 1	KPI 2	KPI 3	KPI 4	KPI 5	KPI 6	KPI 7	KPI 8	KPI 9	KPI 10	KPI 11	KPI 12					
Agricultural Floodplains	8	40	12	1	82	2530 2320	0.4	5 7		20	(100) 13				4	6	3
Commuting Hills	4		40		25	100 100		2		20	80			2	2		
Southern Forests	2.5	20	9		9	530 450				15	18			1	4		
Productive Plains	14	90	56		54	325 90	0.4	5		15	127			2	2	1	
Upland Slopes	5	40	37		13	60 101	0.4			15	69			1	1		
Urban										10					10	10	
TOTAL	33.5	190	154	1	183	6606	1.2	19	0	95	407	0	0	6	23	17	3

Boosey Creek - Tungamah) GBCMA, Broken River – upstream of Lake Nillahcootie,(GB CMA), Catchment resilience – Buxton (GB CMA)Dry wetland – Broken River floodplain (GB CMA), Field Monitoring (GB CMA), Lake Benalla – pest plant encroachment (GB CMA), Hughes Creek Rock Pool (J and L Dalzeal)

Kirwans Bridge

PART D

Implementing the Strategy

CHAPTER EIGHT:

Implementing the Strategy

8.1 IMPLEMENTING THE STRATEGY

Previous Chapters of the Strategy detail the priority management issues and identifies priority waterways and the strategies and programs required to maintain and protect their resilience and the range of values they contain.

A range of supporting actions "Foundation Actions "are necessary for the successful implementation of this strategy to ensure the maintenance and protection of our waterways. These range from the implementation of on-ground waterway protection works (as highlighted in the previous Chapter) to influencing planning, undertaking maintenance and engagement of partners.

Underpinning the success of this strategy, and the success of works to date, has been the recognition of the substantial contribution made by our community and stakeholders.

> We will work together with stakeholders including community groups, local government and water authorities in the region throughout the life of this Waterway Strategy.

The Chapter reminds us of the vast amount of work the community has achieved over many years. This strategy, and its components, is not starting at a base level, we are building on the success of works undertaken through successful partnerships between the community, government agencies and the Catchment Management Authority.

This chapter outlines these management approaches underpinning this Strategy, including: Maintenance, Enforcement, MERI (Monitoring Evaluation, Reporting and Improvement), Community Engagement, Information Sharing and assignment of Roles and Responsibilities.

8.2 MAINTENANCE

The aim of the Strategy is to maintain and enhance waterways through protecting the resilience of the systems. Maintenance of the systems together with maintenance of previous investment is critical element of the program. Maintenance of investment includes, but is not limited to:

- Riparian (control of pest plants and animals, maintain effectiveness of fencing, control grazing)
- Structural works (ensure ongoing effectiveness)

The Technical Guidelines for Waterway Management (Guidelines) represent current best management practice and incorporate advances in environmental and technical practice for river health restoration and maintenance, since the publication in 1991 of the Guidelines for Stabilising Waterways. A summary of the nature of the activity and maintenance recommendations are shown in Table 8.1. The costs associated with Maintenance, Compliance, Best Practice is shown in Table 8.1

Table 8.1 Statement of Obligations (Maintenance, Compliance, Extension and Engagement and Best Practice)

Catchment Wide			Maintenance / Extension		
Long-term Resource Condition	1. Riparian Condition (on targeted low priority) waterways is maintained / improved by 2021.				
	2. Channel Form (on targeted low priority) waterways is maintained / improved by 2021.				
	3. In stream Habitat (on targeted low priority) waterways is maintained or improved by 2021.				
	4. Water Quality (on targeted low priority) waterways is maintained or improved by 2021.				
Management Outcome Targets			Management Activity/Output	Quantity	Lead agency/partner
M.1	Improved vegetation structure and diversity throughout reach	M 1.1	Control invasive pest plant species	10 ha p.a.	Parks Vic, YYNAC joint management
		M 1.2	Control pest animals (invasive species)	10 ha p.a.	Parks Vic, YYNAC joint management
M.2	Water Quality will be maintained or improved	M 2.1	Provide fencing and revegetation incentives	10km p.a.	GB CMA, Parks Vic, Local Government
M.3	Increase knowledge and partnerships	M 3.1	Provide extension efforts within each SES to maintain SOO and role of "caretaker"	$350k p.a.	(all)
M 4	Maintenance of previous works to ensure on-going effectiveness	M 4.1	Deliver Maintenance of historic works	$100k p.a.	
M5	Extension and Partnerships (incl Monitoring and Community Support)	M 5.1	Provide support, information sharing and community partnerships	$300 p.a.	
Estimated cost of maintenance activities (8 years)					**$ 7,700,000**
Estimated cost of maintenance activities (per annum)					**$ 962,500 p.a.**

Table 8.2 - Maintenance Recommendations (from Technical Guidelines for Waterway Management, 2007)

Activity	Recommendations
Alignment Training	Check for accumulation of debris which may either overload the structure or reduce its permeability. Clear debris if necessary. Check for evidence of scour at the structure which may indicate that the structure is not sufficiently permeable. Adjust if necessary or place scour protection. Check for signs of abutment failure and correct as necessary. Encourage vegetation in embayments between structures. This should take the form of planting or direct seeding upon completion of construction with follow up planting to fill areas where the vegetation did not become established initially. Check the structural integrity of the retard. This includes broken piles and scour holes. These have proven to be areas that require a systematic check at regular intervals.
Rip Rap (Bank protection)	Check regularly for excessive settling of riprap along the bank. Check regularly for evidence of scour along the toe of the riprap. Pay particular attention to the stability of the bank at the downstream end of the riprap. Check for evidence of bank slumping associated with overbank flood waters re-entering the channel
Rock Chutes / Fish passage	Initial high flows will remove some of the smaller material from the chute surface. Ensure that no significant voids, surface irregularities or loose rocks concentrate flow and threaten the integrity of the rock layer. Place additional rock where necessary. Some settlement of the rock mass sometimes occurs. Excavate and replace additional rock if the integrity of the rock layer is threatened or where differential settlement creates rills or low areas. Guard against vegetation establishing in the chute itself where it may cause acceleration of flow around the obstruction or dislodge rock if it is dragged out during a flood. Inspect the chute during high flows to ensure it is performing according to design expectations. Carefully inspect abutments for any sign of tunnelling or piping of bank material. Excavate and repair if necessary. Regularly inspect the chute face and crest for loss of material and potential unintended channelisation or concentration of flow. Monitor bed levels immediately downstream of the chute for scour at the end of the apron. Place additional rock as required.
Riparian	Evaluate conditions of riparian zone Ensure management conditions are being adhered to Reduce grazing pressure to acceptable limits Control pest plant and animals Surveillance of weeds Replant (is loss of stock is greater than 10%)
Vertical slot fishways	Ensure operation and maintenance guidelines are followed Ensure debris build up is manage to allow access to fishway Ensure fishway is operational during time of potential fish migration periods. Maintain covers in good condition to prevent predation on fish within structure
GPT	Clean at regular intervals

8.3 BEST PRACTICE

Best practice is considered to be actions or activities (including method, process or techniques) that have regularly delivered the desired results or goals of a program.

The Waterway and Wetland program, over a period of years, has established a range of publications which documents what is considered "Current Best Practice". It should be noted that "Best Practice" continually evolves as we learn from projects, through monitoring, in an adaptive management framework. Reference Material and Further Reading which is considered "Current Best Practice" underpinning this Strategy is included in Table 8.3.

Table 8.3 - Reference Material and Further Reading which is considered "Current Best Practice" underpinning this Strategy

Recommended Strategy	Reference Material / Further Reading
Riparian Management	Department of Sustainability and Environment (2007) Technical Guidelines for Waterway Management Rip Rap (Edition 18) Inlands Rivers and Riparian Zones Rip Rap (Edition 22) Riparian Research Price and Lovett (1999) Riparian Land Management Technical Guidelines Vol 2), LWRRDC
Revegetation	Department of Natural Resources & Environment ( ) Revegetation Guide for the Goulburn Broken Catchment, Edited by Gill Earl, Fleur Stelling, Mary Titcumb and Sue Berwick. Department of Natural Resources & Environment see: http://www.gbcma.vic.gov.au/default.asp?ID=biodiversity_pubs
Willow Management	Department of Primary Industries (2007), Willows, A Management Guide, DPI Frankenberg J (2004) Goulburn Broken Catchment Willow Management Strategy, Goulburn Broken Catchment Management Authority, Shepparton
Weed Management	Blood K (2002) Best Practice Management Guide For Environmental Weeds – General Guidelines, Department of Natural Resources and Environment (www.weeds.crc.org.au) E. Bruzzese, F. Mahr and I. Faithfull, (2000) Best Practice Management Guide For Environmental Weeds - Blackberry, Rubus fruticosus aggregate, Keith Turnbull Research Institute and Weeds CRC, Melbourne Elissa van Oosterhout (2009) ,Weeds of National Significance (Cabomba Control Manual), Department of Primary Industries NSW
Habitat (In-stream)	Rip Rap (Edition 16) Managing snags and large woody debris River Habitat Rehabilitation Through Resnagging (undated) Arthur Rylah Institute, Department of Natural Resources and Environment
Alignment Training	Department of Sustainability and Environment (2007) Technical Guidelines for Waterway Management
Erosion Control (bed and banks) / Bed seeding	Department of Sustainability and Environment (2007) Technical Guidelines for Waterway Management
Irrigation Extraction / native fish	Cameron, L. and Baumgartner, L. 2005. Native fish in irrigation supply offtakes. Brochure prepared by the NSW Department of Primary Industries as part of a project funded by the Murray Darling Basin Commission (Project No. R5006). 4pp. Tim Blackley (2003) Screening Irrigation Offtakes in the Murray-Darling Basin to Reduce Loss of Native Fish
Urban Wetlands	Melbourne Water (2005) Constructed Wetland Systems Design Guidelines for Developers
Urban Stormwater	CSIRO (2006) Urban Stormwater, Best Practice Environmental Management Guidelines< Melbourne Water, Melbourne
Water Quality (General)	SKM (2004), Water Quality Current Recommended Practices (CRPs) for the Goulburn Broken Catchment, Goulburn Broken Catchment Management Authority, Shepparton
Timber Harvesting	Code of Practice for Timber Production 2007
Evidence used to determine the confidence for association of values and their threat	Department of Sustainability and Environment (2009) Confidence Levels for the AVIRA Association Values, Sustainable Water, Environment & Innovation Division, Department of Sustainability and Environment
Linking Actions to address threats	Department of Sustainability and Environment (2011) Report for Conceptual Models for Regional Strategies for Healthy Rivers and Wetlands, GHD and Riverness

8.4 COMPLIANCE

In addition to the implementation of natural resource programs through direct works or incentives, a key responsibility for agencies is to ensure that relevant rules and regulations are followed – compliance. Compliance[5] means being compliant with regulations, standards and relevant laws. There are a number of authorities which have responsibilities to ensure that the relevant rules and agreements are followed to ensure the maintenance of waterways and wetlands. The Goulburn Broken CMA works closely with all these authorities to investigate and address issues as appropriate to the legislation under which they function. It is important that compliance actions are managed and rules and regulations are observed and followed.

Table 8.4 define key areas of compliance and management for the maintenance of the catchment's waterways and wetlands.

Table 8.4 – Compliance Roles and Actions

Action	Role / Responsibility - Compliance Management
Regulating Works altering a waterway	The Goulburn Broken CMA has the functions under the *Water Act 1989* to assess works on waterway applications, and where appropriate, issue licences to construct works. Works undertaken without licence are deemed illegal (unauthorised). 'Works' in this context means something that is capable of being constructed or operated (eg. access crossings, culverts and bridges, river erosion control works, pipeline crossing, weirs etc). Applications are assessed to ensure the proposed works will have no adverse impacts and will result with the desired and approved outcome.
Regulating Activities on waterways (GB CMA By Law)	The Goulburn Broken CMA has the functions under the *Water Act 1989* (By Law) to assess activities on waterway applications, and where appropriate, issue permits to undertake activities. Activities undertaken without a permit are deemed illegal (unauthorised). Activities include removal of sand and gravel, revegetation of river banks and stream clearing.
Floodplain Activities	referrals and advice about *Water Act 1989* matters relating to planning permits under sections 55 and 52 of the *Planning and Environment Act 1987*. Providing advice or approval to development authorities (predominantly councils) on planning permits and subdivisions(and to a much lesser extent, building permits).
Catchment / LandUse Planning	Local Government Authority – responsible authority for the *Planning and Environment Act* and role in Native Vegetation Retention and land-use planning. *Municipal Strategic Statements*, can identify environmental values and objectives in a Local Government Are (LGA), zoning for use, overlay and schedules of exemptions, policy to conserve and protect, and other land-use planning tools.

[5] Definitions

- adherence to standards, regulations, and other requirements
- conforming to environmental laws, regulations, standards and other requirements

Table 8.4 (continued) – Compliance Roles and Actions

Action	Role / Responsibility - Compliance Management
Waterway Condition (General)	The *State Environment Protection Policy (Waters of Victoria)* sets the framework for government agencies, businesses and the community to work together to protect and rehabilitate Victoria's surface water environments. The state environment protection policies that protect Victoria's water environments are: *State Environment Protection Policy (Waters of Victoria)* and *State Environment Protection Policy (Groundwaters of Victoria)*. These are administered by the EPA.
Riparian Condition (licenced)	Crown Water Frontages are generally licenced to adjoining landholders by Public Land Services, DEPI, with conditions that define appropriate management and responsibilities of the licensee. To ensure the Crown Water Frontage is maintained in 'good order' as required by the licence, specific and measurable minimum standards are being defined. These minimum standards are to better guide licensees in their management decisions and will better equip DEPI with triggers for compliance action where frontage condition is degrading. Breeches in licence conditions, including those outlined in a Riparian Management Agreement attached to a licence, are dealt with by DEPI. Compliance actions may be undertaken on activities such as vegetation destruction, vehicles off-road, dumping of waste, unauthorised natural resource extraction, building construction and unauthorised camping.
Riparian Condition (un licenced)	Grazing of unlicensed Crown Land is considered unauthorised occupation and can instigate compliance actions by DEPI. Similar to licenced Crown Water Frontage, any activity that causes deterioration to riparian condition is illegal and subject to compliance action.
Riparian Condition (freehold)	See above regulation of "works" and "activities" It is a role of Local Government to administer planning permits and/or undertake compliance related vegetation management on freehold land, including along streams. The Goulburn Broken CMA may assist with technical advice where invited to do so.
Native Vegetation	Local Government
Litter	EPA has a key role in protecting Victorians and the environment from litter. Under the *Environment Protection Act 1970*, littering is illegal. EPA officers, local government officers, police and other enforcement agencies can issue 'on the spot' fines for littering.
Waste	EPA is responsible for the management and enforcement for the primary legislation for waste management in Victoria (under the *Environment Protection Act 1970*). Primary legislation provides the regulatory framework for society by imposing restrictions and controls on the activities of individuals and corporate bodies.
Waterway Incidents (pollution / chemical spills / natural events / Dead Stock)	The Partnership Agreement has the intention of clearly establishing the framework for leadership, and providing guidance in operations, communications and investigation of waterway incidents. This is considered essential to ensure a coordinated approach and in order to maintain the confidence of the public while all agencies carry out their respective roles in protecting, restoring and maintaining the quality of the waterways. The key agencies with regulatory or functional responsibilities for waterways in the Goulburn Broken Catchment are: Goulburn-Murray Water; Environmental Protection Authority (EPA); Department of Environment and Primary Industries; Goulburn-Broken Catchment Management Authority; Goulburn Valley Region Water Authority; North East Region Water Authority; and Department of Health.
Fish Deaths	Waterway Incident (Fish Death) Response Guideline applies to government agencies and authorities with responsibilities under a range of legislation for management of the environment, waterways, fisheries and health. It describes expected organisational roles and responsibilities and enables a framework to establish regional response plans that describe incident management arrangements, regional contacts, communication processes and review processes. It is intended that the regional arrangements will be included in regional and municipal emergency plans.

8.5 MONITORING AND EVALUATION

The management of rivers, estuaries and wetlands in the region is conducted within an adaptive management framework. At the core of adaptive management is the ability to learn from previous experience and update management approaches to reflect the knowledge gained during implementation. Figure 8.1 presents the eight-year adaptive management cycle of the Victorian Waterway Management Program and regional Waterway Strategies. The cycle includes (DEPI, 2013b):

Strategy and Planning – state policy framework and targets, planning for waterway management through regional waterway strategies with priorities and regional targets

Implementation and Monitoring- Government and other investment in regional priorities, implementation of priority management activities, intervention monitoring and long-term resource condition assessment

Evaluation and reporting- management reporting, intervention monitoring reporting, resource condition reporting, program evaluation and improvement

Community participation and research and innovation occur across all parts of the program. This knowledge and information is crucial for ensuring effective adaptive management and informing associated monitoring, evaluation and reporting processes (DSE, 2012).

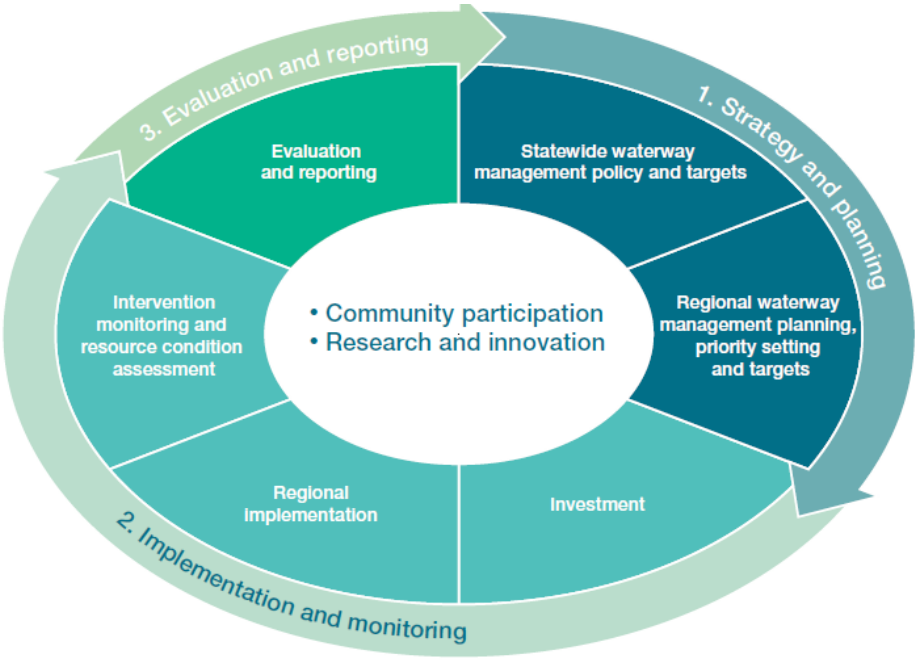


Figure 8.1. The eight-year adaptive management cycle of the Victorian Waterway Management Program and regional Waterway Strategies (Source: DEPI, 2013b)

A detailed monitoring, evaluation and reporting plan has been developed to support adaptive management from planning to Strategy completion. The monitoring, evaluation and reporting plan:

- presents the program logic underpinning the Strategy
- clarifies the assumptions associated with the program logic and identifies strategies to manage potential risks
- identifies the key questions for evaluation and establishes processes to monitor progress within the framework of the state-wide monitoring program
- clarifies the communication and reporting needs and identifies the processes required to support these needs

- enables lessons learned from monitoring and evaluation to be gathered and inform improvement.

The MER plan will be reviewed, at minimum, on an annual basis to ensure it remains current and relevant to informing adaptive management.

8.5.1 PROGRAM LOGIC

Program logic is an approach to planning (commonly used in natural resource management) that uses a diagram to demonstrate the rationale for a program and express how change is expected to occur.

The program logic provides the rationale for how the RWS will contribute to the vision for Victoria's waterways, identified in the Victorian Waterway Management Strategy and the Goulburn Broken region's vision, identified in the Goulburn Broken Regional Catchment Strategy (CMA, 2013).

Vision for Victoria's waterways - "Victoria's rivers, estuaries and wetlands are valued, health and well-managed; supporting environmental, social, cultural and economic values that are able to be enjoyed by all communities"

Vision for the Goulburn Broken region – "Healthy, resilient and increasingly productive landscapes supporting vibrant communities"

The simplified program logic for the RWS is illustrated in Figure 8.2. It describes how each year, specific management activities and outputs are delivered by regional agencies in order to achieve particular management outcomes. Over the eight-year planning period, these outputs and outcomes collectively contribute to either maintaining or improving the environmental condition of waterways. In the long-term, this will ensure that Victoria's waterways can continue to support environmental, social, cultural and economic values.

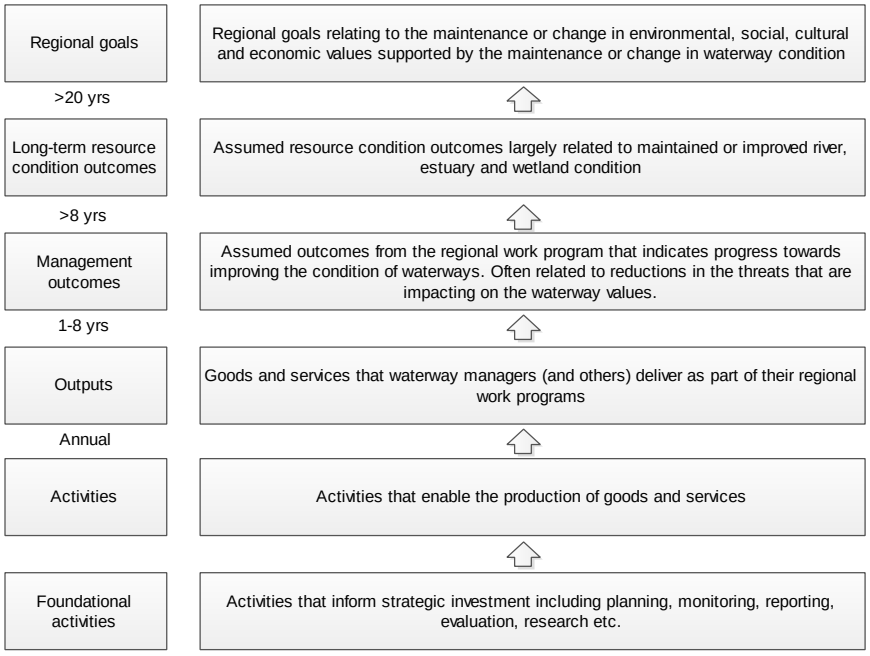


Figure 8.2. Program logic for regional Waterway Strategy

8.5.2 MONITORING

Monitoring activities are targeted to inform evaluation and reporting on Strategy implementation. Monitoring activities also include the collection of information relating to foundational influences and externalities that impact on Strategy implementation. Foundational influences include factors such as climatic variability, drought, flood, bushfire and potential impacts of climate change; and externalities include factors such as land use change, population growth, government support, economic conditions, community expectations and landholder attitudes.

Monitoring activities will be consistent with the state-wide monitoring processes coordinated through the Victorian Waterway Management Program. This program includes targeted resource condition and intervention monitoring to inform both state and regional evaluation and reporting processes.

8.5.3 EVALUATION

The strategy and planning phase of the adaptive management cycle (Figure 3) includes the development of pre-determined key evaluation questions by which to assess the Strategy and gain new knowledge and information. Evaluation questions provide the basis for evaluation design and associated monitoring processes.

Evaluation of the Strategy will include an assessment of the extent to which the outcomes have been achieved at each level of the program logic underpinning the Strategy. It will also address the assumptions in the program logic and provide direction and improved knowledge for subsequent planning cycles.

The evaluation questions developed for the Strategy address the following 5 categories (DSE, 2012):

Impact - changes to resource condition, management activities or institutions

Appropriateness - addressing the needs of beneficiaries and against best practice

Effectiveness - achievement of desired management outputs and resource condition objectives

Efficiency - value or return from investment

Legacy - after the activity/program ends

The scale and frequency of evaluation will vary throughout the life of the Strategy, and will include an annual review cycle and more detailed reviews in the third and final year of the Strategy.

The annual reviews will assess progress towards the planned management activities and outputs, and associated financials. These reviews will consider any new knowledge and information that may require changes to planned management activities and outputs. The annual review will be undertaken by the CMA and will align with regional investment processes.

The three year review will also assess progress towards management activities and outputs, and where possible, review progress towards management outcomes. This review may also provide new knowledge and information that may lead to an update of the Strategy to support an adaptive approach.

The final review of the Strategy will focus on capturing all of the knowledge gained during implementation of the Strategy, and an assessment of achievements and progress against the Strategy targets. This will ensure that there is a clear record of achievements and lessons learned, and an evidence base for updating or changing regional programs and management approaches in the future. This final review will be undertaken through an independent process.

Case Study - Waterwatch in the Goulburn Broken Region

Waterwatch is a community water quality monitoring program that has been operating in the Goulburn Broken catchment since 1993. The program, coordinated and delivered by Goulburn Valley Water, brings together school and community groups, concerned individuals and landowners, local councils and water corporations.

Monitors test the quality of their local stream or water source so that practical actions can be taken to maintain and improve water quality. The program provides water testing gear to interested people and trains them to use that equipment correctly.

A large body of water quality data has been collected since the program's inception and can be viewed at: http://www.vic.waterwatch.org.au. Community volunteer monitors from widely separated sites can share their results to quickly identify problem areas. The more we understand the issues around river health, the better we can care for our waterways.

The data is also used by resource management agencies to monitor river health changes following improvement works.

8.5.3 REPORTING

Reporting is an important tool to ensure accountability for the investment of government funds into waterway management activities. Over the long-term, consistent and effective reporting provides evidence to evaluate and communicate the effectiveness of the Strategy (DEPI, 2013b).

Annual management reporting is a component of the annual review cycle, and includes reporting on the activities and outputs achieved for the year and associated financials. This reporting is delivered through the CMA Annual Report, and annual investment reports for existing funding arrangements with the State Government. This reporting generally comprises both tabular and spatial information. Financial audits are required to ensure that reported expenditure is accurate and accountable. These audits will be led by DEPI and provides assurance that investment in delivering outputs has been strategic, cost effective and consistent (DEPI, 2013b).

Public reporting against Strategy management outcome targets will occur, at a minimum, following the final review of the Strategy. The CMA will also support reporting of management outcome targets for the Victorian Waterway Management Strategy in 2016 and 2020. These reporting processes will be informed through the reviews undertaken in the third and final year of the Strategy.

Resource condition reporting is led through the Victorian Waterway Management Program. This involves the collection, analysis and reporting of information on the condition of Victoria's waterways every eight years, subject to available funding (DEPI, 2013b). This reporting, combined with regional knowledge, provides the collective data to assess the condition of waterways over the long term.

The monitoring, evaluation and reporting plan for the Strategy identifies further detail of the key stakeholders at organisational, community, regional, state and Commonwealth levels who should be kept informed on the progress of the Strategy or would benefit from Strategy information. It also identifies what they need to know and how it will be communicated.

8.5.5 KNOWLEDGE GAPS AND RESEARCH

The process of developing the program logic and evaluation questions demonstrates the areas where critical knowledge gaps exist. The monitoring, evaluation and reporting plan for the Strategy identifies the key knowledge gaps identified through this process, and also identifies the strategies for addressing them. These strategies may involve collating existing information or proposing areas for further research programs. To align with the Victorian Waterway Management Program the Strategy will support research that:

- provides essential knowledge to address critical short-term and/or strategic long-term knowledge gaps. The resulting research findings will be incorporated into policy and management.
- targets knowledge gaps or low confidence in the relationships between outputs, management outcomes and long-term resource condition outcomes (if significant for waterway management and investment) (DEPI, 2013b).

Research will be directed to investigating those relationships where there is little scientific evidence, or the confidence in the evidence is low. This targeted approach to research also provides an increased focus on prediction and testing of these predictions, rather than more general, descriptive research. It is also vital that research is targeted to better understanding the effectiveness of management activities in which there is significant Victorian Government investment (for example, riparian revegetation) (DEPI, 2013b).

Over the past 15 years the Goulburn Broken Catchment Management Authority and partners have invested significant resources to address knowledge gaps and to better understand assumptions that are made with respect to this and related programs. Table 8.5 presents the list of identified knowledge gaps (GB CMA, 2005) and the action taken.

Table 8.5 - Identified knowledge gaps (GBCMA, 2005) and the action taken

Knowledge gap	Recommended Action / Activity	Status
Water Quality Data	Implement key findings of the report into water quality monitoring in the catchment. Consider spatial nature of WQ data and encourage extension to current project as necessary.	A review of water quality monitoring was undertaken across all programs. This led to a rationalization of water quality sites. Sites were established to reflect extreme events (these were subsequently removed after 4 years)
ISC Data	Conduct 5 yearly evaluations of stream condition and develop Catchment Report Card. Increase spatial nature of assessments Review ISC assessment process, including validation of results and Data Storage	ISC was undertaken by the Department of Sustainability and Environment (now Department of Environment and Primary Industries) in 2010.
Water Temperature	Investigate impacts of degraded riparian zones on water temperature	Not funded
Assets and Values	Commence assessment and collect available data on additional assets and threats associated with river health	Additional asset and threat data was captured and included in AVIRA.
Trout cod	Investigate potential new locations for stocking or translocation of Trout cod, as outlined in the Trout cod Recovery Plan	Investigation underway for the re-establishment of Trout cod in Hughes Creek. Preliminary brief for habitat and geomorphic investigation prepared.
Representative Rivers	Following the 2004 ISC evaluation, identify a reach suitable for Representative River for the North Central Floodplains River Region	No action taken
Economic Analysis	Determine the economic value of healthy rivers within the Goulburn/Broken region (project underway by DSE)	No action taken

8.5.6 STRATEGIC ACTIONS

Action	Timeframe	Responsibility
Annual Monitoring Plan be established for the Waterway Program	2013 - 2021	GB CMA, Partners.

The Monitoring Plan is to consider the follow project themes:

Theme	Considerations	Estimated Resourcing
Water Quality	Contribution to the Regional Water Quality Monitoring Program Monitoring Costs	$70,000 pa.
Native fish	Movement, populations/status and breeding, habitat.	$100,000 pa.
Flows	VEFMAP WETMAP (under development) CEWH - Goulburn River long term intervention monitoring (CEWH funding for 5 years) Barmah TLM (future unknown past 2013-14)	$120,000 pa. TBA TBA $50,000
Wetland/Flow	Mentoring the ecological response of wetlands and streams to environmental watering	$75,000 pa.
Waterway Condition	IWC and ISC (every 5 years)	(TBA)
Weeds	Monitor for and control new aquatic pest plants in wetlands Monitoring control options for aquatic weeds	$50,000 pa.

8.6 COMMUNITY ENGAGEMENT

Community engagement activities to implement the Goulburn Broken Regional Waterway Strategy will be informed by the 2013-14 Goulburn Broken CMA Community Engagement Strategy and Action Plan (see Figure 8 3. For the strategy and action plan framework) and guided by the Community Engagement and Partnerships Framework (Figure 8.4) for Victoria's Catchment Management Authorities (November 2012).

The 2013-14 *Goulburn Broken CMA Community Engagement Strategy and Action Plan* prioritises:

- Ongoing stakeholder analysis
- Continuous investigation and development of appropriate community engagement tools/approaches
- Inclusion of a community engagement component in all project planning and development (including a focus on each SES)
- Increased staff capability in community engagement.

  Community engagement was critical to developing this Goulburn Broken Regional Waterway Strategy. Engagement activities included:

- Establishment of a Reference Group comprised of community members and representatives from partner agencies such as Department of Environment and Primary Industries and Goulburn-Murray Water
- Development of a WeConnect site to seek feedback on the development of the Strategy.
- Completion of an interactive survey, seeking input on values, threats, and support for management
- A request for waterway photographs through Flickr, many of them used in this publication
- Regular newsletters and updates sent to all interested parties
- Regular updates in the Goulburn Broken CMA's monthly newspaper column (distributed 55,000+)

These activities have built a solid body of knowledge, contacts and networks that once the Goulburn Broken Regional Waterway Strategy is finalised will provide a useful springboard in helping guide efforts to implement it.

Given the Goulburn Broken Regional Waterway Strategy is a long-term plan for improving our waterways and wetlands, providing specific details of implementation engagement activities is unrealistic, however, the diagram below demonstrates the broad approach:

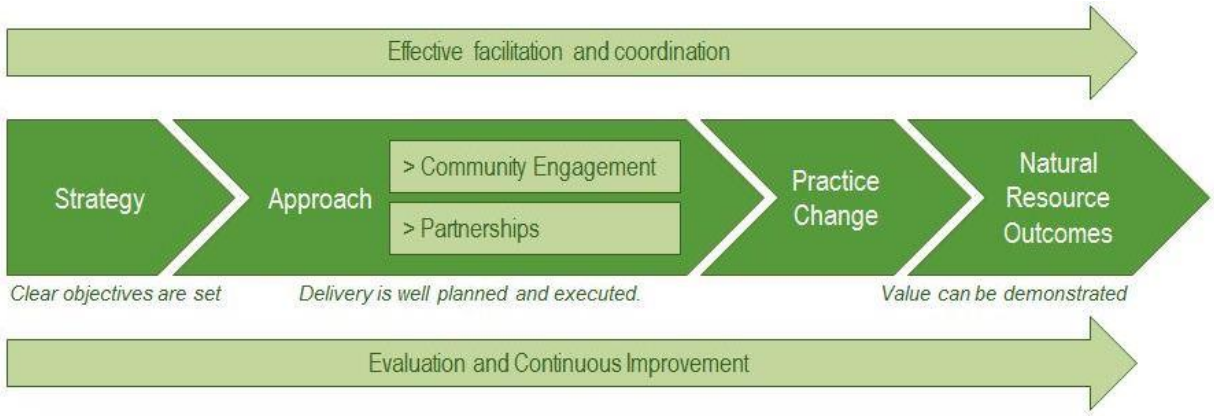


Figure 8.3 - Community Engagement and Partnerships Framework for Victoria's Catchment Management Authorities - an overview of the community engagement and partnerships approach

Importantly, all efforts will be guided by the five principles that underpin the Community Engagement and Partnerships Framework for Victoria's Catchment Management Authorities:

1. We will embed community engagement and build partnerships in all that we do
2. Our people will be actively supported to engage communities and to build partnerships
3. Our community engagement and partnership approaches will be well planned, tailored, targeted, and evaluated
4. We will provide meaningful opportunities for our communities and partners to contribute to strategies and initiatives
5. We will work transparently and respectfully with our communities and partners, and establish clear roles and expectations.

These principles recognise that as the CMA does not own or directly manage natural resources, to achieve agreed outcomes and meet our responsibilities we must proactively and effectively engage and work with others to deliver initiatives that achieve improved catchment health and sustained practice change.

All engagement activities will be complemented by the 2013-14 *Goulburn Broken Communication and Marketing Strategy and Action Plan*, and sub-strategies including the Goulburn Broken Environmental Water Communication and Media Plan (due to be completed October 2013).

Ongoing evaluation of the effectiveness of community engagement activities is essential to ensuring they remain relevant and target the right people, in the right way.

Their effectiveness will be measured by:

- Evidence communities are further informed and engaged in NRM
- New partnerships or relationships have been established
- There is evidence of practice change in the community
- Partnerships are healthy and productive
- There is facilitation of an integrated approach to NRM

ACTION: An Annual Community Engagement Plan will be developed for the Strategy Implementation		
Responsibility:	Goulburn Broken Catchment Management Authority	**Timeframe** Annually

Figure 8.4 - Updated 2013 Community Engagement Strategy framework

1. Why develop this strategy?

To achieve actions on the ground and improvements in natural resource management (NRM) practice the Goulburn Broken CMA must engage the community and stakeholders.

Community engagement - the mutual participation of stakeholders in formation of policy and service delivery.

2. Who is this strategy targeting?

Stakeholders - this includes but is not limited to Goulburn Broken CMA staff, partners and investors; land managers; the community; industry; and all levels of government.

3. What will this strategy achieve and how will this measured?

Well-developed, strong partnerships that help the Catchment deliver on the RCS.

Increase the resilience and capability of NRM groups so they can be the custodians of the Catchment.

An engaged community will:

- **have Input into the design/direction-setting of local projects;**
- **demonstrate improved/devolved decision-making skills;**
- **have faith in the Goulburn Broken CMA's role in NRM in the catchment as described in the RCS ; and**
- **advocate on the Goulburn Broken CMA's behalf.**

4. How will this strategy be implemented?

Development of a Community Engagement Action Plan will prioritise:

Ongoing stakeholder analysis

Continuous investigation and development of appropriate community engagement tools/approaches

Inclusion of a community engagement component in all project planning and development (including a focus on the SESs)

Increased staff capability in community engagement

5. When will the Community Engagement Strategy and Action Plan be implemented and reviewed?

The Community Engagement Strategy and Action Plan are designed to be flexible, dynamic and responsive documents that reflect the constantly evolving environment the Goulburn Broken CMA and its stakeholders operate in. The Communication and Marketing Manager will take the lead in supporting program managers to review the strategy annually and the action plan at least twice a year.

8.7 ROLES AND RESPONSIBILITIES

For effective waterway management it is vital to clearly outline:

- institutional arrangements and the roles, responsibilities and partnerships for waterway management
- funding arrangements for waterway management activities
- accountability for complex management issues, such as new and existing structures in waterways.

The general roles of key management groups within the catchment are shown in Appendix A. This is reproduced from the Victorian Waterway Strategy (DSE 2013).

8.8 COST-SHARING PRINCIPLES FOR WATERWAY MANAGEMENT PROGRAMS

While the framework for waterway management outlined in this draft Strategy will ensure that resources are directed to the areas of highest priority and to the most effective means of waterway maintenance and improvement, the achievement of the vision for waterways is a significant task requiring considerable resources and long-term commitment.

Beneficiaries that need to be considered include:

- water corporations, given their dependence on a healthy resource base and their potential impacts on healthy waterways
- direct beneficiaries (for example, recreational groups, private landholders)
- local government representing regional economic benefits (for example, increased tourism)
- the broader Victorian community
- owners and managers of public infrastructure

It is important to ensure that funding mechanisms reflect the general cost-sharing principles for natural resource management and truly represent, in a fair and equitable way, the impacting groups and the various beneficiaries relating to waterway management.

The cost-sharing principles for waterway management programs will be applied in the implementation of the regional Waterway Strategies. Contributions of beneficiaries for activities that are part of the implementation of regional Waterway Strategies will be negotiated during the planning process.

Duty of care

All natural resource users and managers have a duty of care to ensure that they do not damage the natural resource base. They are responsible for making good any damage incurred as a result of their actions.

Beneficiary pays

When it is not possible to attribute damage, then primary beneficiaries should pay. Users, both existing and future, are expected to pay for activities that provide private benefits. Contributions from secondary beneficiaries will, where appropriate, be negotiated with the primary beneficiaries.

Government contributions to private beneficiaries

Government contributes primarily for activities which produce public benefits. Government may agree to contribute to land and water management activities that provide private benefits, where the cumulative uptake of these activities provides significant public benefit and government support is required to facilitate this uptake.

Positive benefit-cost

Before Government will contribute to any land or water management activity, the activity must be technically sound, the benefits must justify the costs and it must be considered a priority activity.

Private cost-share contributions

Actions will be prioritised on the basis of the most public benefit for the least public cost. Where the public cost of an action is reduced by financial and in kind contributions by private or corporate stakeholders, this will influence the level of priority for the action.

Upfront and maintenance costs

Waterway managers will collaborate with private landholders, and with other government agencies, to bring a built asset up to a declared standard, after which, in general, the maintenance of the built asset condition will be the responsibility of the beneficiary.

Disasters

The cost of repair and recovery of essential public assets following natural disasters will be in accordance with the nationally agreed natural disaster relief and recovery arrangements.

State-wide policy and monitoring

Government will contribute to the cost of state-wide planning, state-wide resource monitoring and assessment, and research and investigations where they are crucial to sustainable land and water management.

8.9 STRATEGY REVIEW

The Strategy contained within the document is dynamic, however the fundamentals of the values, threats and issues to be addressed are unlikely to change within the time of this strategy's delivery (2013/14 to 2020/21).

The Identified Programs, Implementation Targets for the next eight years (2013-2020) will be followed and two key review processes built into the Strategy Framework.

Mid Term Review (after three years): A mid-term review of this strategy will be undertaken in 2018/19, after four years which will be used to assess progress towards targets and may lead CMAs to change or update management actions and targets as required.

Eight Year Review: A full review of the strategy will be undertaken in 2020/21 at the completion of the implementation period. This review will reflect on achievements made, whether progress is adequate, and consider whether there is new science and knowledge that needs to be taken into account and incorporated.

ACTION: A mid-term review of this strategy will be undertaken, after three years which will be used to assess progress towards targets and may lead CMAs to change or update management actions		
Responsibility:	Goulburn Broken Catchment Management Authority	**Timeframe** 2015/2016

ACTION: A full review of the strategy will be undertaken of the Strategy at the completion of the implementation period		
Responsibility:	Goulburn Broken Catchment Management Authority	**Timeframe** 2020/2021

8.10 IMPLEMENTATION SCHEDULES

Implementation of the recommended strategies in Section 4 and 7 is reliant on the support from State and Federal Governments, partner agencies and the community. Depending on this level of support a different implementation schedule may result.

Program	Resources		Program	Resources	
AF 1-5	$	132,000	AF 6	$	4,880,000
AF 7	$	5,000,000	AF 8	$	400,000
AF 9-10	$	90,000	AF 11-13	$	237,500
AF 14 -18	$	495,000	AF 19-21	$	1,692,000
AF 22-25	$	1,122,000	AF 26-30	$	575,000
AF 31-32	$	50,000	AF 33-37	$	780,000
AF 38-40	$	3,075,000	AF 40-42	$	110,000
AF 43	$	105,000	AF 44-47	$	770,000
AF 48-50	$	100,000	AF 51	$	126,000
AF 52	$	50,000	AF 53	$	34,000
AF 54-56	$	139,000			
AGRICULTURAL FLOODPLAINS			$	19,962,500	
PP 1-4	$	212,000	PP 5-9	$	525,000
PP 10-14	$	415,000	PP 15-17	$	230,000
PP 18-23	$	1,190,000	PP 24-28	$	540,000
PP 29-32	$	550,000	PP 33-34	$	97,000
PP 35-38	$	2,805,000	PP 39	$	-
PP 40-42	$	115,000	PP 40 - 41	$	4,637,500
PRODUCTIVE PLAINS			$	11,316,500	
US 1-4	$	300,000	US 5-6	$	160,000
US 7-9	$	240,000	US 10-13	$	705,000
US 14-15	$	194,000	US 16-18	$	180,000
US 19	$	35,000	US 20-21	$	155,000
US 22-23	$	290,000			
UPLAND SLOPES				$	2,259,000
CH 1-2	$	545,000	CH 3-6	$	650,000
CH 7-10	$	1,070,000	CH 11-14	$	1,250,000
CH 15	$	50,000			
COMMUTING HILLS				$	3,565,000
SF 1-3	$	152,000	SF 4-5		70000
SF 6-8	$	140,000	SF 9		325000
SF 10-14	$	640,000	SF 15		
SF 16			SF 17-18		1,000,000
SOUTHERN FORESTS				$	2,327,000

Maintenance Statement of Obligations (Maintenance, Compliance, Extension and Engagement and Best Practice)	$962,500 p.a.
Management of the Environmental Water Reserve	$340,000 p.a.
Statutory Functions (Floodplain Management / Works on Waterways	$550,000 p.a.

SECTION NINE:

References and Further Reading

Anne Pisarski and John Cary and The State of Victoria Department of Sustainability and Environment (2010), Victorian Waterway Health Social Condition Benchmarking Project, Department of Sustainability and Environment, Melbourne

Australian River Restoration Centre website http://arrc.com.au/

Bennett, A., Radford, J.andHaslem, A. (2006). Properties of land mosaics: implications for nature conservation in agricultural environments. Biological Conservation133(2), 250 -264.

Chesterfield, E. (1986) Changes in the vegetation of the river red gum forests at Barmah, Victoria. Australian Forestry, 49: 4-15.

Chesterfield, E. A., Loyn, R. H. & Macfarlane, M. A. (1984) Flora and fauna of Barmah State Forest and their management. Forests Commission of Victoria, Victoria.

Coates, D.J. Atkins, K.A. (2001). Priority setting and the conservation of Western Australia's diverse and highly endemic flora. *Biological Conservation***97**, 251-263.

Colloff, M.J, Ward, K.A. & Roberts, J. (in press) Ecology and conservation of grassy wetlands dominated by spiny mud grass Pseudoraphis spinescens in the southern Murray-Darling Basin, Australia. Aquatic Conservation.

Department of Primary Industries and Environment (2013a) Ministerial Guidelines for the Regional Waterway Strategies. Victorian Government Department of Primary Industries and Environment

Department of Primary Industries and Environment (2013b) Victorian Waterway Management Strategy. Victorian Government Department of Primary Industries and Environment unpublished report

Department of Primary Industries and Environment (2013c) DEPI Output data standard. Victorian Government Department of Sustainability and Environment

Department of Primary Industries and Environment (2013d) Index of Stream Condition – refer to http://www.depi.vic.gov.au/water/water-resource-reporting/Third-Index-of-Stream-Condition-report

Department of Sustainability and Environment (2011) My Victorian Waterway – Personal connections with rivers, estuaries and wetlands in Victoria. Victorian Government Department of Sustainability and Environment

Department of Sustainability and Environment (2002) Victorian River Health Strategy, Department of Sustainability and Environment, Melbourne

Department of Sustainability, Environment, Water, Population and Communities, (2013) Barmah Forest, http://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=14#

Department of the Environment, Water, Heritage and the Arts and the Department of Agriculture, Fisheries and Forestry (2012) Australian Government Caring for our Country Monitoring, Evaluation, Reporting and Improvement Plan - MERI Plan Template v0.2. Commonwealth of Australia

Department of the Environment, Water, Heritage and the Arts and the Department of Agriculture, Fisheries and Forestry (2009) Developing and using program logic in natural resource management. Commonwealth of Australia

Department of Envivinment and Primary Industries (2013), Draft Victorian Waterway Management Strategy. Victorian Government Department of Environment and Primary Industries unpublished report, Melbourne.

Department of Environment and Primary Industries (2013a) In stream Woody Habitat Assessment Department of Environment and Primary Industries Melbourne

DSE (2004a) Atlas of Victorian Wildlife. Department of Sustainability and Environment, Victoria.

DSE (2004b) Victorian Flora Information System. Department of Sustainability and Environment, Victoria.

DSE (2008) Barmah Forest Ramsar Site ecological character description. Victorian Government Department of Sustainability and Environment, Melbourne.

DSE (2009) Northern Region Sustainable Water Strategy, Department of Sustainability and Environment, Melbourne

DSE (2012) draft Victorian Waterway Management Strategy, Department of Sustainability and Environment, Melbourne.

DSE (2012), Monitoring, Evaluation and Reporting Framework for Land, Water and Biodiversity. Victorian Government Department of Sustainability and Environment, Melbourne.

DSE (2012), Report for Conceptual Models for Regional Strategies for Healthy Rivers and Wetlands, Report to the Department of Sustainability and Environment, GHD and Riverness.

DSEWPC (2013) Australian Ramsar Wetlands: Barmah Forest. URL address: http://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=14. Accessed 12/08/2013. Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Doeg T (2009) Confidence Levels for the AVIRA Association Values, Prepared for Sustainable Water, Environment & Innovation Division, Department of Sustainability and Environment, Melbourne

Dyer, F, El Sawah, S, Lucena-Moya, P, Harrison, E, Croke, B, Tschierke, A, Griffiths, R, Brawata, R, Kath, J, Reynoldson, T, Jakeman, A, 2012, Predicting water quality and ecological responses. National Climate Change Adaptation Research Facility, Gold Coast.

Ede, F.J. and Hunt T.D. (2008), Habitat management guide—Riparian: Weed management in riparian areas: south-eastern Australia. CRC for Australian Weed Management, Adelaide

GB CMA (2005) Goulburn Broken Regional River Health Strategy 2005-2015. Goulburn Broken Catchment Management Authority, Shepparton

GB CMA (2009) Goulburn Broken Regional River Health Strategy 2005-2015, Addendum. Goulburn Broken Catchment Management Authority, Shepparton

GB CMA (2013) Goulburn Broken Regional Catchment Strategy, Goulburn Broken Catchment Management Authority, Shepparton

Geoscience Australia (2013) Australian Government, website, Understanding Groundwater Resources, Groundwater Dependent Ecosystems

GHD (2012) Department of Sustainability and Environment - River and Estuary Conceptual Models to Support Development of Regional Waterway Strategies. GHD - Unpublished client report

GHD (2012) Report for Conceptual Models for Regional Strategies for Healthy Rivers and Wetlands, Department of Sustainability and Environment, Melbourne.

Holland, Clift and Davies (2007), Willows National Management Guide: current management and control options for willows (Salix spp.) in Australia. Victorian Department of Primary Industries, Geelong.

Loyn, R.H., Lumsden, L.F., & Ward, K.A. (2002) Vertebrate fauna of Barmah Forest, a large forest of River Red Gum Eucalyptus camaldulensis on the floodplain of the Murray River. Victorian Naturalist 119: 114-132.

MDBA (2011) The Living Murray story — one of Australia's largest river restoration projects. Murray-Darling Basin Authority, Canberra.

Montecillo O. (2012) Analysis of economic data: Goulburn Broken Catchment. Unpublished report. Department of Primary Industries, Victoria.

Morris, K. and Papas, P (2012) Wetland conceptual models: associations between wetland values, threats and management interventions. Arthur Rylah Institute for Environmental Research, Unpublished client report, Department of Sustainability and Environment, Heidelberg, Victoria

Norris, K. (2004). Managing threatened species: the ecological toolbox, evolutionary theory and declining-population paradigm. Journal of Applied Ecology 41, 413-426.

Roberts, K., Kenway, J. and Miles, C. (2009). Reviewing the mix of methods to accelerate progress to achieving biodiversity targets in a Victorian Catchment Management Authority. *Australasian Journal of Environmental Management***16(3)**, 149-157

SKM (2005) Barmah Forest Groundwater Monitoring Review to May 2004. Report prepared for Goulburn-Murray Water. Sinclair Knight Merz, Victoria, Australia. (62pp)