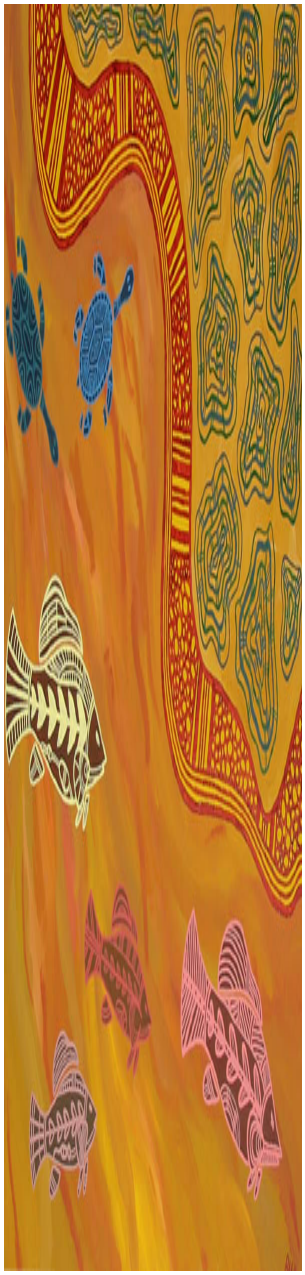
Goulburn Broken
Regional River Health Strategy

2005 - 2015



GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

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Ministers Foreword

The Goulburn Broken Regional River Health Strategy is one of ten strategies developed across the State to implement key river health objectives outlined in the Bracks Government's action plan for water, Our Water Our Future and the Victorian River Health Strategy.

This strategy is the result of extensive community involvement. Community input into the strategy development is essential. It provides a framework for communities, industries and Government to work in partnership with river health managers to restore and manage our rivers over the long-term.

This river health strategy establishes regional priorities for river protection and restoration. It will be used by a wide range of stakeholders and community groups and steer river health investment.

It identifies priority waterways throughout the Goulburn and Broken River Basins from the headwaters in the Great Dividing Range through to the River Murray.

The Goulburn and Broken Basins are regarded by many as the 'flood bowl' of the Murray Darling Basin and are of significant economic value to Victoria. They are also environmentally significant and a key focus of Victoria's contribution to meeting the Living Murray environmental flow commitments. These systems are also highly valued by the community for their social and recreational assets.

The Goulburn Broken Regional River Health Strategy uses an innovative asset-based approach. This allows river health managers to acknowledge the range of social, environmental and economic values of local waterways. It also helps in identifying the threats and risk to these values so that the priority actions to protect and restore our rivers are clearly established.

I congratulate the Goulburn Broken catchment communities for this innovative strategy.

Your valuable contribution in protecting and restoring our precious rivers will benefit all Victorians.

John Thwaites,
Minister for Water and Environment

Foreword

From the irrigated Goulburn and Murray Valleys to the dryland grazing and cropping regions and high country valued for its tourism and recreational uses, the Goulburn Broken catchment is the foundation of the Victorian and Murray Darling Basin water resources and economic wealth. Although only 2% of the Murray Darling Basin's land area, the catchment generates 11% of the basin's water resources. In addition the catchment generates 26% of the rural export earnings for the State of Victoria.

The future economic, social and environmental outlook for the Goulburn Broken Catchment is strong. We have a robust regional economy that continues to attract new investment and a community which values the assets provided by the land and water.

Water underpins the viability of our irrigation area that, in turn, is the foundation of the region's economy and community. Streams within the region are highly valued for a range of reasons: irrigation, industry, potable water supply, stock and domestic water supply, recreation (both passive and active), the presence of threatened and vulnerable fish species, aesthetic beauty and biodiversity. Stream health in the region is of vital importance, not only for the local region but also for communities over 500 km downstream.

The need to protect and enhance the condition of our river environments is widely recognised. The aim of this strategy is to identify rivers of high value for protection and enhancement and to identify opportunities for restoration or improving the environmental condition of other rivers throughout the catchment.

The Strategy is the first attempt to combine all elements of river management under one umbrella document and provides direction for the protection and enhancement of the regions river systems.

While this strategy highlights the need for on-ground action it also highlights the importance of capacity building, research, monitoring and adaptive planning. This Strategy provides the best possible framework for addressing the issues and challenges, so that as a community we can contribute towards the protection of one of our most valued assets – our river environment.

We commend this Strategy to all, confident that it will provide direction for these assets to be protected for future generations.

On behalf of our community we wish to acknowledge the input and leadership provided by the River Health and Water Quality Committee in the development of this draft Strategy, together with CMA staff, Implementation Committees and Waterway Working Groups, our partners and the community for contributing to the development of the Strategy document.

Stephen Mills
Chair – Goulburn Broken Catchment Management Authority

Suzanna Sheed
Chair – River Health and Water Quality Committee

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Additional Information

Acknowledgements

The Goulburn Broken Regional River Health Strategy has been prepared by the CMA. The project has been led by the River Health and Water Quality Coordinating Committee with the assistance of the Board, the Implementation Committee's, Waterway Working Groups, agency partners and the community. Members of the River Health and Water Quality Committee were (in alphabetical order, with affiliations):

- Jill Breadon — Mid Goulburn Broken Implementation Committee
- Murray Chapman — Community representative
- Royce Dickson — Community representative
- Allen Gale and John Anderson — Goulburn Valley Water
- Brian Greed — Community representative
- Peter Howarth — Upper Goulburn Implementation Committee
- Elita Briggs — EPA
- Hubert Miller — Community representative
- Russell Pell — Chair of Shepparton Irrigation Region Implementation Committee
- Shane Papworth / Pat Feehan — Goulburn Murray Water
- Bruce Radford — DSE
- Suzanna Sheed — Community representative (Committee Chair)

The River Health and Water Quality Committee would like to acknowledge the contribution of the following people to the development and production of the Regional River Health Strategy:

The Technical Panel responsible for the analysis and preparation of the draft strategy:

- Tim Doeg — Macroinvertebrates (Senior Researcher)
- Judy Frankenberg — Vegetation, wetlands
- Shelley Heron — Catchment management (Project Manager)
- John McGuckin — Fish
- Arthur Sovitslis — Database management
- Geoff Vietz — Geomorphology
- Graeme Aitkinson — Indigenous Culture

Also:

Wayne Tennant (GBCMA), Fleur Jaques (GBCMA), Tarmo Raadik (DSE), Paul Wilson (DSE), Leon Metzeling (EPA).

Representatives from the following organisations which contributed towards the development and review of this strategy – key River Health Strategy contacts from the Department of Sustainability and Environment, the Department of Primary Industries and the Environment Protection Agency.

Front cover painting "The River" by Rebecca Aitkinson.

Photographs: Contributions from Jim Castles, Tony Kubeil, Dustin Lavery, Rebecca Nicoll and Richard Warburton

Accompanying Reports

Three supplementary documents are associated with this Strategy:

GBCMA (2005) *Regional River Health Strategy 2005-2015. Appendices*. Goulburn Broken Catchment Management Authority, Shepparton.

GBCMA (2005) *Regional River Health Strategy 2005-2015. Status of the Riverine System – Regional Overview*. Goulburn Broken Catchment Management Authority, Shepparton.

GBCMA (2005) *Regional River Health Strategy 2005-2015. Status of the Riverine System – Waterways in Focus*. Goulburn Broken Catchment Management Authority, Shepparton.

The latter two documents provide summary information on the environmental, social and economic values in the Goulburn Broken Catchment.

Acronyms and Abbreviations used in this report

AROT	Australian Rare or Threatened Species
BMP	Best Management Practice
CMA	Catchment Management Authority
CRP	Current Recommended Practice
DSE	Department of Sustainability and Environment
DPI	Department of Primary Industries
DO	Dissolved oxygen
EC	Electrical conductivity
EPA	Environment Protection Authority
EPBC	*Environment Protection and Biodiversity Conservation Act* 1999
EVC	Ecological Vegetation Class
GBCMA	Goulburn Broken Catchment Management Authority
GL	Gigalitre (1,000 Megalitres)
GMW	Goulburn Murray Water
IC	Implementation Committee
ISC	Index of Stream Condition
LCC	Land Conservation Council
MER	monitoring, evaluation and reporting
ML	Megalitre (1,000,000 litres)
NRE	Department of Natural Resources and Environment (now DSE and DPI)
NRM	natural resource management
RHS	Regional River Health Strategy (this document)
RHWQC	Riverine Health and Water Quality Committee
SEPP (WoV)	State Environmental Protection Policy (Waters of Victoria)
TCRT	Trout cod Recovery Team
TN	Total nitrogen
TP	Total phosphorous
VFF	Victorian Farmers Federation
VRHS	Victorian River Health Strategy
WWG	Waterway Working Group

Executive Summary

The Goulburn Broken Catchment is home to 189,500 people and is regarded by many as the 'food bowl' of the Murray Darling Basin. The region's agriculture output – estimated to be worth $1.35 billion a year – supports a regional economy that has an annual economic output of $7.8 billion and employs about 77,000 people (GBCMA, 2002).

The region has abundant natural resource assets and the strength of the region relies on the ecosystem services these assets generate. The way we manage our water, land and biota assets is critical to the future sustainability of the region and its community.

The Goulburn Broken Regional Catchment Strategy identified river health and waterway management as one of our highest priority natural resource management issues in the Goulburn Broken catchment. In order for our Catchment Community to protect and enhance the rivers and streams within the region, there is a need to develop a Regional River Health Strategy.

The Goulburn Broken Regional River Health Strategy (2005-2015) builds on existing river-related action plans, implementation plans and strategic documents, supported by a series of sub-strategies and discussion papers, to achieve the vision for Goulburn Broken Catchment rivers and streams:

VISION: *'……'Healthy rivers, streams, wetlands, floodplains and adjacent land that support a vibrant range and abundance of natural environments, provides water for human use, sustains our native flora & fauna and provides for our social, economic and cultural values.……..'*

In 2004, Victorian Government released "Our Water, Our Future". This document strengthens the role of Catchment Management Authorities as care takers of river health and gives them management of the Environmental Water Reserve.

Government has also recently released the "Our Environment Our Future: Victoria's Environment Sustainability framework". The framework strengthens Victoria's commitment to maintaining and restoring our natural assets for a prosperous and liveable Victoria.

The Goulburn Broken Regional River Health Strategy fits into the broader government vision for the management of water in the State to ensure that rivers are managed in accordance with relevant Victorian Government policies. These include many Victorian catchment management arrangements, including the *Victorian River Health Strategy, Regional Catchment Strategies*, the *State Environment Protection Policy (SEPP) (Waters of Victoria)*, the White Paper *Our Water Our Future*, the *Victorian Biodiversity Strategy*, the *Victorian Nutrient Management Strategy, Victoria's native Vegetation Management – A Framework for Action*, and *Victoria's Salinity Management Framework*.

The Regional River Health Strategy provides a framework for integration of actions which will enable rivers of high quality to be protected and others to be improved in quality for current and future generations.

The process for developing the Regional River Health Strategy reflects the community engagement and partnership principles adopted by the GBCMA and its partners. The community was actively engaged during production of many background documents and in discussion forums used to prepare the strategy.

The Goulburn Broken Regional River Health Strategy aims to achieve four main objectives for the rivers and streams of the Goulburn Broken Catchment:

- Enhance and protect the rivers that are of highest community value (environmental, social and economic) from any decline in condition;
- Maintaining the condition of ecologically healthy rivers;
- Achieving an 'overall improvement' in the environmental condition of the remainder of rivers;
- Preventing damage from inappropriate development and activities.

The Regional River Health Strategy identifies a number of High Priority Reaches within the Goulburn Broken catchment. These include rivers that are "of greatest value to the community", and rivers that are currently "ecologically healthy". For the Strategy, reaches of the highest community value in the Goulburn Broken Catchment are identified as:

- Heritage Rivers;
- Reaches associated with International or Nationally significant wetlands;
- Reaches classified as environmental Sites Of Significance;
- Regional Representative Rivers;
- Reaches with records of water-dependant nationally listed endangered flora and fauna species located within 100 m of the watercourse;
- Reaches classified as having very high overall environmental significance;
- Reaches classified as having very high overall social value; and
- Reaches classified as having very high overall economic value.

Forty-four High Priority Reaches were identified in the Goulburn Broken Catchment, based on high community value or rivers that are currently ecologically healthy.

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.

The Strategy also identified 13 reaches within the catchment that can potentially be improved to ecologically healthy condition, and other opportunities for restoration or improving the environmental condition of other rivers throughout the catchment.

The Goulburn Broken Regional River Health Strategy will be delivered in seven separate programs, targeting the four key elements outlined in the Strategy development, as well as monitoring and research, and community engagement:

- Program A – Protection and Enhancement of High Priority Reaches
- Program B – Protection of Ecologically Healthy Rivers
- Program C – Creating More Ecologically Healthy Rivers
- Program D – Improvements to other reaches
- Program E – Preventing damage from inappropriate development and other activities
- Program F – Community Engagement and Building Capacity
- Program G – Monitoring, Evaluating and Reporting

Program A – Protection and Enhancement of High Priority Reaches

Program A addresses key issues in forty-three reaches in the Goulburn Broken catchment identified as High Priority Reaches (those of high community value for environmental, social and economic values).

Priority Reach (reach no.)	Key issues
Goulburn River (1-8)	Bank erosion, Channel modification, Flow deviation, Loss of Instream habitat, Stock access, Water quality, Wetland connectivity.
Goulburn River (9-14)	Algal blooms, Bank erosion, Barriers to fish migration, Bed instability, Flow deviation, Introduced flora, Loss of Instream habitat, Riparian vegetation quality, Stock access, Water temperature, Water quality.
Goulburn River (15)	Water quality.
Goulburn River (16)	Introduced flora, Riparian vegetation quality.
Seven Creeks (19, 20)	Stock access, Water quality.
Goborup Creek (33)	Flow deviation, Stock access.
Hughes Creek (37)	Barrier to fish migration, Stock access.
King Parrot Creek (51)	Barrier to fish migration, Stock access, Water quality.
Yea River (55)	Barrier to fish migration, Stock access.
Acheron River (62)	Loss of instream habitat, Stock access.
Taggerty River (64)	Maintaining healthy state.
Rubicon River (66)	Maintaining healthy state.
Big River (67)	Maintaining healthy state.
Big River (68)	Water quality.
Howqua River (69)	Maintaining healthy state.
Howqua River (70)	Maintaining healthy state.
Delatite River (71)	Barrier to fish migration, Bed instability, Introduced flora, Riparian vegetation quality, Stock access, Water quality.
Delatite River (72)	Maintaining healthy state.
Broken River (1)	Flow deviation, Stock access, Water quality.
Broken River (2)	Barrier to fish migration, Flow Deviation, Stock access, Water quality.
Broken River (3)	Channel modification, Barrier to fish migration, Flow Deviation, Stock access, Water quality, Water temperature
Broken River (4)	Barrier to fish migration, Channel modification, Flow Deviation, Stock access, Water quality, Water temperature
Broken River (5)	Barrier to fish migration, Channel modification, Introduced flora, Riparian vegetation quality, Stock access, Water quality.
Holland Creek (13,14)	Barrier to fish migration, Channel modification, Stock access, Water quality.
Ryans Creek (17)	Maintaining healthy state.
Broken Creek (21)	Flow deviation, Stock access, Water Quality .
Broken Creek (22, 23)	Flow deviation, Stock access.
Broken Creek (24)	Flow deviation.
Broken Creek (25, 26)	Flow deviation, Water quality.

Program B – Protection of Ecologically Healthy Rivers

Program B protects existing assets in the five river reaches identified as ecologically healthy waterways from any future threats to the ecologically healthy status:

- Taggerty River (Goulburn Basin Reach 64);
- Goulburn River (Goulburn Basin Reach 15);
- Big River (Goulburn Basin Reach 67);
- Big River (Goulburn Basin Reach 68); and
- Ryans Creek (Broken Basin Reach 17).

Program C – Creating More Ecologically Healthy Rivers

Program C targets the thirteen reaches have been identified as approaching ecologically healthy river status that can relatively simply be improved to ecologically healthy status.

Reach (no.)	Key issues
Goulburn River (16)	Poor riparian width and continuity, exotic vegetation.
Bylands Creek (36)	Poor in-stream habitat.
Dry Creek (48)	Poor in-stream habitat.
Yea River (54-57)	Poor riparian width and continuity, stock access.
Murrindindi River (59)	Poor riparian width and continuity.
Acheron River (63)	Poor riparian width, stock access.
Rubicon River (65)	Poor riparian width and continuity, stock access.
Howqua River (69,70)	Poor riparian width.
Holland Creek (15)	Poor riparian width.

Program D – Improvements to other reaches

Program D focuses on achieving an 'overall improvement' in the environmental condition of rivers not identified as high priority, through broad scale riparian and frontage management actions.

Program E – Preventing damage from inappropriate development and other activities

Program E identifies regulatory controls on developments that can affect river health and proposes co-ordination between agencies to maximise efficiencies to deliver river health outcomes.

Program F – Community Engagement and Building Capacity

Program F identifies actions to ensure that local communities are fully engaged and committed through their participation and capacity to become involved.

Program G – Monitoring, Evaluating and Reporting

Program G outlines the requirements for monitoring, evaluating and reporting progress of the River Health Strategy in achieving the objectives of the Strategy and the targets of the individual actions.

Program Costs

The overall cost of the program for all priority actions is estimated at $125,000,000 over the ten year life of this strategy. Detail within each program area follows:

Program	**Program Objective**	**Cost ($',000s) 2005-2015**
Program A: Protection and Enhancement of High Priority Waterways	Protect and enhance identified high value environmental, social and economic assets over 1,060 km of river	$113,300
Program B: Protection of Ecologically Healthy Rivers	Ecologically Healthy River status maintained over 112 km or river	$1,000
Program C: Creating More Ecologically Healthy Rivers	286 km of river improved to Ecologically Healthy River status	3,990
Program D: Improvement to other rivers	Rehabilitation of the streamside zone over 20% of non-priority reaches by 2014	4,093
Program E: Preventing damage from inappropriate development	No decline in river health condition due to inappropriate development	$0.6
Program F: Engagement and Capacity Building	Ensure that the Goulburn Broken community has the capacity to implement all priority actions that contribute to the objectives of the Regional River Health Strategy	$1,500
Program G: Monitoring, Evaluating and Reporting	An effective monitoring, evaluation and reporting program developed and implemented.	$1,150

The Victorian River Health Strategy identifies a range of targets for the protection and enhancement of river health. Collectively each CMA will be able to measure their contribution to regional and State-wide targets, which have been set for river health. Targets set within this strategy aim to align and contribute towards the stated targets.

Achievement of the "Regional 10-year resource condition targets and their contribution to State-wide targets are reliant on the effective delivery of Management Action (Implementation) Targets and their successful progression towards the stated Resource Condition Targets within each RRHS program.

Implementation Targets RRHS Program Level	Resource Condition Targets - RRHS Program Level	Ten (10) year Regional Resource Condition Targets
		350km of river maintained in excellent or good condition (as measured by ISC#) (1999 benchmark)
		Establishment of Environmental Water Reserve and improve flow regimes achieving flow objectives in 6 high value rivers (21 reaches).
		Reduction/improvement in nutrient loads at key monitoring sites within catchments[1] Reduction in phosphorous exports of 2375 kg/year at Gauge 405204, 1050 kg/year at Gauge 404210, 312.5 kg/year at Gauge 404224, 312.5 kg/year at Gauge 404216, 50 kg/year at Gauge 404207, 225 kg/year at Gauge 404214, 190 kg/year at Gauge 405237 and 250 kg/year at Gauge 405231 Contribute to overall 65% reduction below 1996 levels
		550km of river with protection/improvement in riparian condition (as measured by ISC#)
		550km of river with protection/improvement of physical form subindex (as measured by ISC#)
		Estimated 140km of river where instream habitat has been enhanced / reinstated
		Estimated 225km increase in river length made accessible for fish movement
		5 reaches of stream with Ecologically Healthy River status maintained over 112 km of river. 4 Representative rivers/reaches maintained in good or excellent condition (as measured by ISC#)
		Value of Heritage Rivers maintained
		**Protection/improvement of aquatic life (as measured by ISC#) at key monitoring sites (note that key sites must be clearly defined)
Targets to be developed by 2007/08		Reduction/improvement in salinity loads/concentrations at key monitoring sites within the catchments (note that key sites must be clearly defined)
		Reduction/improvement in sediment loads/concentrations at key monitoring sites within the catchments (note that key sites must be clearly defined)
		*% of relevant SEPP (WoV) objectives met for key monitoring sites (note that relevant objectives and key sites must be clearly defined)

The successful implementation of the strategy will rely on effective management and leadership. This catchment has benefited from many years of co-operative partnerships between the regions partners. We will take advantage of the existing robust networks and cooperative approaches and where necessary build on any identified limitations.

The Catchment Management Authorities, who are the statutory waterway managers and caretakers of river health, are responsible for implementing the bulk of the river health activities. River health related activities undertaken by other agencies such as water authorities, DPI, local government and DSE and associated costs have been identified and documented wherever possible. It is important to recognise that implementation of other action plans and sub-strategies under the Regional Catchment

[1] Based on a reduction of 2.5 kg/km/yr total phosphorous due to fencing and revegetation (see Assumptions in Appendix 14).

Strategies contribute to river health outcomes, and are not directly costed or implemented under this strategy.

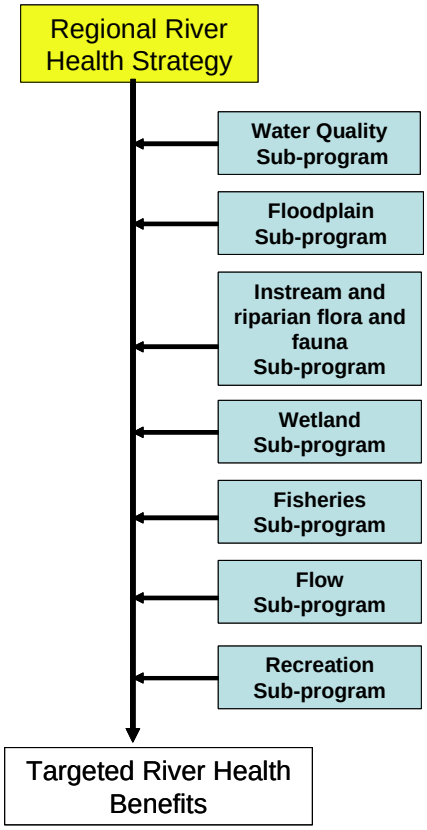
It is important to note that the estimated funding requirements and proposed cost shares are indicative. Catchment Management Authorities coordinate and implement river health related activities on behalf of Government, in accordance with Government policies. Government's investment in this region's strategy is contingent on Government budgets and priorities. The timeline for implementing a strategy's targets may need to be amended in line with the funding provided.

The Strategy contained within the document is dynamic. However, the fundamentals of the issues to be addressed are unlikely to change or priority areas for action. The Programs, Implementation Targets and Resource Condition Targets establish priority actions for the next ten years (2005-2015).

A mid term review of this strategy will be undertaken in 2010 where a detailed evaluation of the progress towards the stated goals and objectives will be undertaken. 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.

1. Introduction

'Healthy rivers, streams, wetlands, floodplains and adjacent land that support a vibrant range and abundance of natural environments, provides water for human use, sustains our native flora & fauna and provides for our social, economic and cultural values.'.[2]



The Goulburn Broken Regional Catchment Strategy (GBCMA, 2002) identified river health and waterway management as one of our highest priority natural resource management issues in the Goulburn Broken catchment. In order for our Catchment Community to protect and enhance the rivers and streams within the region, there is a need to develop a Regional River Health Strategy.

The Goulburn Broken Regional River Health Strategy is the first attempt to combine a number of elements of river management under one umbrella document. The Regional River Health Strategy integrates waterway programs into a multidisciplinary framework and considers water quality, flow, wetlands, instream and riparian flora and fauna, fisheries and recreation.

The Strategy builds on existing river-related action plans, implementation plans and strategic documents and is supported by a series of sub-strategies and discussion papers (Table 1.1, Appendix 1). The Strategy provides a framework for integration of actions which will enable rivers of high quality to be protected and others to be improved in quality for current and future generations.

1.1 Regional Objectives

The Regional River Health Strategy provides the strategic framework for the protection and enhancement of river health and water quality within the Goulburn Broken region.

The Goulburn Broken Regional River Health Strategy therefore aims to achieve four main objectives:

1. Enhance and protect the rivers that are of highest community value from any decline in condition;
2. Maintaining the condition of ecologically healthy rivers (as defined in the VRHS);
3. Achieving an 'overall improvement' in the environmental condition of the remainder of rivers; and
4. Preventing damage from inappropriate development and activities.

[2] Community Vision for the Goulburn Broken (Regional Catchment Strategy, p. 54).

Specific river reach objectives of the strategy include:

- **Goulburn River** "to establish clear management objectives for the Goulburn River to manage the economic, environmental and social values of these systems".
- **Broken River** "to allocate water resources in a way that balances the needs of the environment with those of water users and to improve the ecological health of Broken River, and associated wetlands and floodplains".

To achieve these objectives, the Regional River Health Strategy:

- identifies values associated with our riverine systems;
- identifies stresses which may impact on environmental, economic and social values;
- provides a framework for the development and implementation of issues-based action plans;
- develops local riverine health goals and targets;
- provides a basis for the development and implementation of multi – benefit works and activity programs; and
- allows the identification of gaps in the current management of river health.

Table 1.1. Key sub-strategies and discussion papers included in the Goulburn Broken Regional River Health Strategy (see Appendix 1 for more detailed descriptions)

Key Strategy and Objectives	Key Management Issues
Goulburn Broken Water Quality Strategy (1996-2016) – To protect and enhance the quality of water for native biota, ecosystems and domestic, agricultural and industrial uses within the catchment and downstream.	Reduction of nutrient export
Goulburn Broken Regional Floodplain Management Strategy 2002 – To provide a balance between the natural functions of floodplains to convey and store water with the social and economic benefits the community receive from floodplains.	Protection of public and private assets River / Floodplain linkages
Goulburn Broken Flow Management Discussion Paper – To provide effective control and management over the water cycle with consideration of the environmental, social and economic value provided by the allocation of water.	Water quantity Seasonality and timing of key flow components
Goulburn Broken Recreation Discussion Paper – To provide a process for the balanced management of recreational activity within the riverine environment.	Recreational impacts
Instream and Riparian Flora and Fauna of the Goulburn Broken – To protect and enhance ecological processes and genetic diversity to secure the future of native species of plants, animals and other organisms.	Biodiversity
Goulburn Broken Wetland Strategy – To protect and enhance ecological processes and genetic diversity to secure the future of native species of plants, animals and other organisms.	Wetland area and extent Wetland condition Wetland biodiversity Wetland ecosystem functions
Goulburn Broken Fisheries Management Discussion Paper – To enhance and maintain recreational fishing opportunity for economic, social and environmental assets.	Recreational fisheries

The Goulburn Broken Regional River Health Strategy has been developed under the framework of the Victorian River Health Strategy (VRHS – NRE, 2002). The VRHS outlines the Victorian government's long-term direction for the management of Victoria's rivers. It provides a vision for the management of rivers in Victoria, policy direction on issues affecting river health and a blueprint for integrating efforts on rivers, ensuring that effective river health benefits are achieved by the resources invested. A key philosophical change in the VRHS policy is the approach of "protecting the best", rather than spreading limited resources across all environmental issues affecting river health.

The VRHS provides the framework for regional communities to make decisions on river protection and restoration, and to find the balance between using rivers and maintaining their ecological condition.

The VRHS fits into the broader government vision for the management of water in the State to ensure that rivers are managed in accordance with relevant Victorian Government policies. These include many Victorian catchment management arrangements, including the *Regional Catchment Strategies*, the *State Environment Protection Policy (SEPP) (Waters of Victoria)*, the *Victorian Biodiversity Strategy*, the *Victorian Nutrient Management Strategy*, *Victoria's native Vegetation Management – A Framework for Action*, and *Victoria's Salinity Management Framework*.

In June 2004, the Victorian Government released the White Paper, *Our Water Our Future*, an action program including new initiatives to secure Victoria's water for the next 50 years. The White Paper is a key policy document aimed at guiding water management in Victoria into the future, and needs to be considered in the development of the Goulburn Broken Regional River Health Strategy.

The White Paper identifies a number of key initiatives in the Goulburn Broken Catchment, including:

- identifying the CMA as the caretaker of river health (including establishment of the environmental water reserve, progress of regional stream flow and groundwater management plans, etc..);
- 165,000 ML environmental water for Murray and Victorian tributaries;
- Establishment of Environmental Water Reserves and Improved Flow Regimes in the Goulburn and Broken Rivers;
- River Murray icon site gains water – Barmah Forest;
- Lake Mokoan to be returned to wetlands;
- making 'sales' water into secure, tradeable entitlements;
- irrigation channel upgrade and new technology for Tatura;
- projects to improve on-farm water efficiencies and reuse systems;
- pipeline for efficiency of Tungamah supply, saving 4,000 ML;
- water recycling projects;
- $30 million for dam safety and $50 million for irrigation system improvements; and
- Eildon Dam wall improvements.

Along with the Victorian River Health Strategy, the *State Environment Protection Policy* (SEPP) *(Waters of Victoria) 2003* is a key Statewide statutory policy for surface waters in Victoria. The regional environmental, social and economic assets used in the Regional River Health Strategy equate, in general terms, to the "beneficial uses" protected by the *SEPP (Waters of Victoria)*.

The SEPP includes a range of actions required to protect and restore river health. Many of these actions form part of this Regional River Health Strategy and sub-strategies as appropriate.

The SEPP contains objectives for water quality and biological health. These environmental quality objectives provide the 'benchmarks' that describe the environmental quality needed to protect all beneficial uses/assets. The Regional River Health Strategy works to integrate these objectives as resource condition targets where appropriate.

While the Goulburn Broken Regional River Health Strategy provides a holistic approach, a number of the sub-strategies contain a number of specific actions relevant to other priorities of the Regional Catchment Strategy, or priorities that address specific issues for investment. These actions are not to be devalued because they are not priorities identified in the Regional River Health Strategy.

Similarly, it is possible that not all of the actions required to address river health are identified in existing sub-strategies. Where this occurs the Regional River Health Strategy aims to identify gaps and recommend processes for them to be addressed.

2. Introduction to the Goulburn Broken Catchment

The Goulburn and Broken Basins (Figure 2.1) are situated in northern Victoria and form part of the Murray-Darling Basin. The two basins cover just under 2.4 million hectares, or 10.5% of the area of Victoria, and 2% of the Murray-Darling Basin's land area. Despite this relatively small area, the catchment generates 11% of the basin's water resources.

By far, the major land use in the Goulburn Broken Basins is general dryland agriculture, covering over 1.4 million hectares (62% of the area of both basins - Table 2.1). The dryland area generates $1.9 billion in economic activity each year. The basins also support a large food processing industry with production from the irrigation region (covering only 9% of the area) contributing 25% of Victoria's export earnings. Total catchment production value is approximately $7.8 billion per annum (Michael Young and Associates, 2001).

Table 2.1. Major land use in the Goulburn and Broken Basins

Land use type (ha)	Goulburn	Broken	Total
Native Vegetation (forested)	544,000	111,650	655,650
General agriculture (dryland)	916,800	532,070	1,448,870
Intensive agriculture (irrigation)	110,400	99,330	209,730
Plantation (pines)	6,400	16,940	23,340
Urban	1,600	770	2,370
Total (ha)	**1,579,200**	**760,760**	**2,339,960**

2.1 The Goulburn River Basin

The Goulburn River basin (Figure 2.2) is Victoria's largest, covering over 1.6 million hectares or 7.1% of the state's total area.

The terrain varies significantly across the catchment, from the high ranges and mountains of the Great Dividing Range in the south, to the flat country of the Murray Plain to the north. The high country in the south east experiences cold winters with persistent snow and an average annual rainfall greater than 1,600 mm. Rainfall decreases northward, and in the far north of the catchment is less than 450 mm per year, only one third of the annual evaporation in that area. With the higher rainfall, a number of the Goulburn River's major tributaries rise on the northern slopes of the Great Dividing Range. These include the Big, Delatite, Howqua and Jamieson rivers.

Native vegetation has been retained over much of the mountainous south of the catchment, where slopes are steepest. However clearing for agriculture has been extensive in the valleys and plains.

The Goulburn River itself is 570 km long, flowing from upstream of Woods Point to Echuca. The river has a mean annual water discharge of 3,040 GL (1.8 ML/ha), representing 13.7% of the total state discharge. Streamflow along the Goulburn River has been modified by two major features, Eildon Reservoir and the Goulburn Weir.

Figure 2.1 Goulburn Broken Catchment

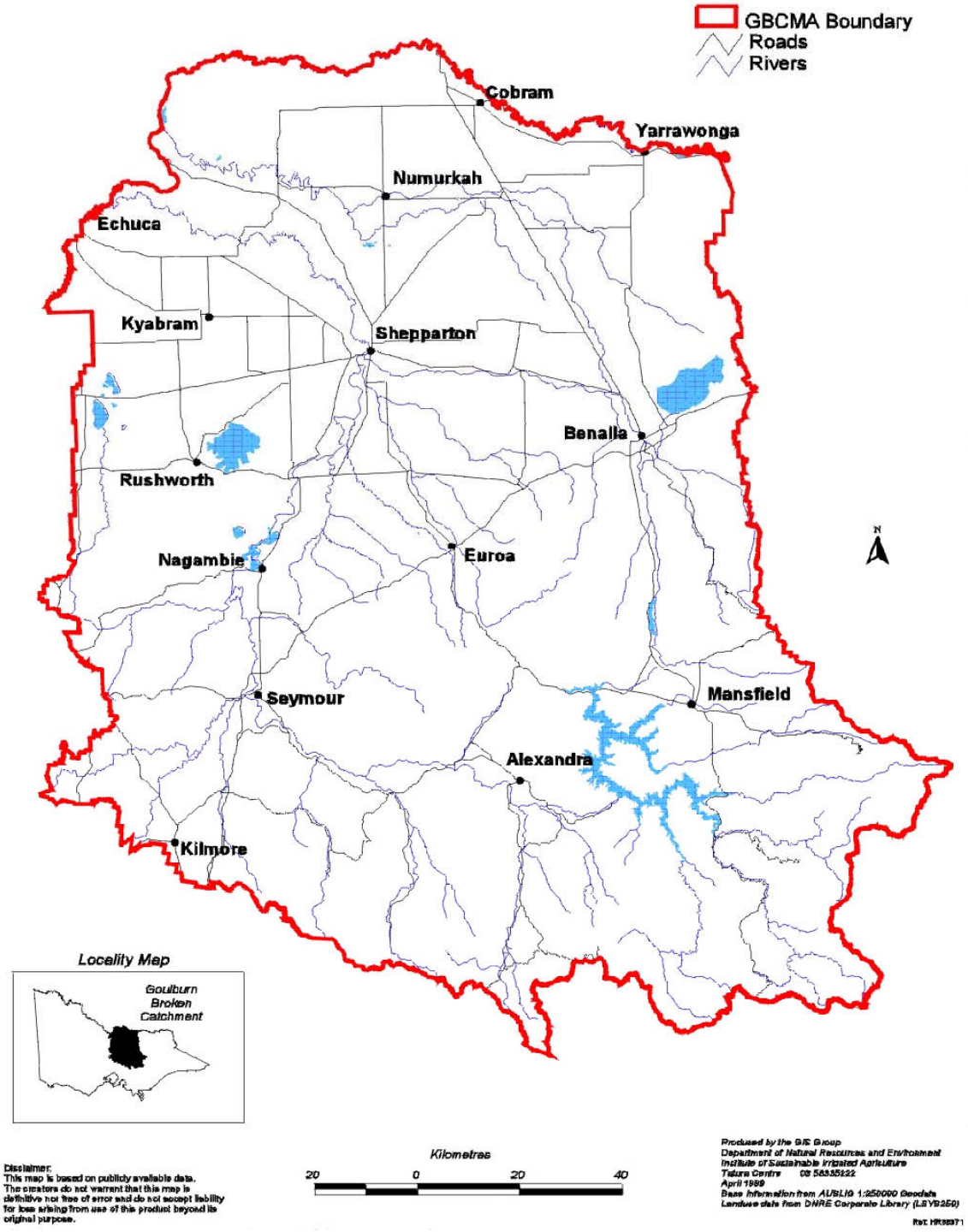
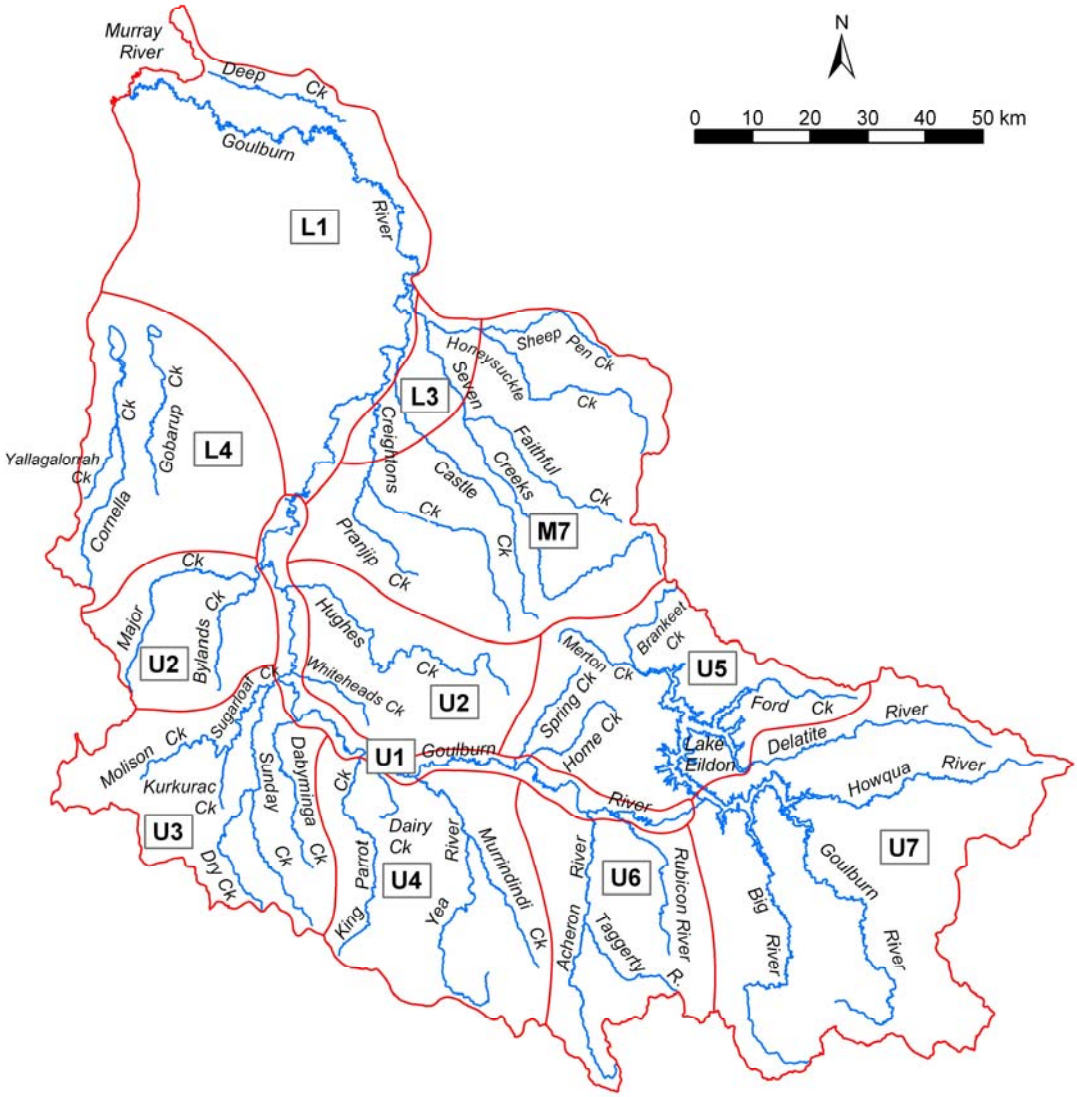


Figure 2.2 Map of the Goulburn Basin showing Management Units



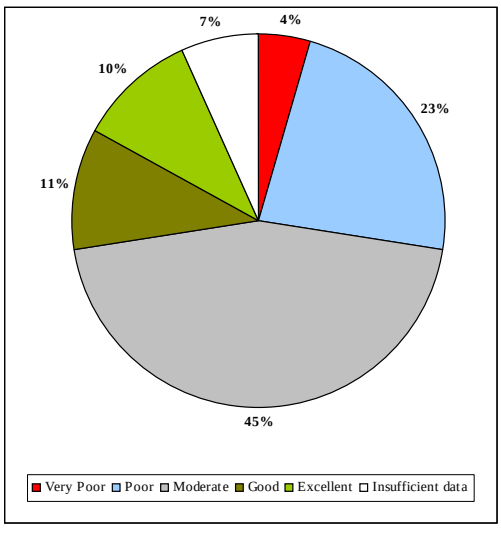
Lake Eildon has a capacity of 3,390 GL and supplies more than half of the water used in the Shepparton Irrigation Region. Operation of Eildon Reservoir has reduced winter/spring flows passing Eildon and increased summer/autumn flows so that the flow regime is reversed from the natural regime. The Goulburn Weir near Nagambie and associated diversion channels to the east and west, have reduced the average annual downstream flow there to 1,340 GL, less than half the pre-regulated flow.

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

For management and reporting purposes, the Goulburn River Basin has been divided into 75 separate reaches[3] and 11 different Management Units (Table 2.2). Only the main stems of the rivers in each reach are included in the length values for each Management Unit, with the total length of rivers of 1,705 km in the Goulburn River basin.

Table 2.2. Management Units within the Goulburn River Basin.

Number	Name	ISC Reaches[4]	Length (km)
L1	Lower Goulburn River and Floodplain	1-8	195.0
L3	Strathbogie Plains	17-18, 21-25, 27, 29	227.5
L4	Western Catchment	30-34	152.5
M7	Euroa Strathbogie	19-20, 26, 28	100.0
U1	Mid Goulburn River	9-14	145.0
U2	Majors Creek and Hughes Creek	35-40	132.5
U3	Sunday/Dry Creeks	41-50	175.0
U4	King Parrot Creek/Yea River	51-59	167.5
U5	Northern tributaries	60-61, 73-75	110.0
U6	Acheron, Rubicon and Taggerty Rivers	62-66	100.0
U7	Upper Goulburn catchment	15-16, 67-72	200.0



The 1999 Index of Stream Condition assessment (Figure 2.) showed that the majority of the Goulburn Catchment was rated as either Moderate (45% of the total river length) or Poor (23%) condition.

Only 10% of the total river length was classified as in Excellent condition, all located in the forested upper tributaries of the catchment.

More details on the regional condition of rivers in the Goulburn catchment can be found in the accompanying report - *Regional River Health Strategy 2005-2015. Status of the Riverine System – Regional Overview*.

Figure 2.3 ISC condition for the Goulburn Basin

[3] The reaches are those identified by the Index of Stream Condition (ISC) assessment. The ISC is a measure of a stream's change from natural or ideal conditions. It presents an indication of the extent of change in respect of five key "stream health" indices: Hydrology; Physical Form; Streamside Zone; Water Quality; and Aquatic Life.
[4] Location of stream reaches can be found in the report - Regional River Health Strategy 2005-2015. Status of the Riverine System – Regional Overview.

2.2 The Broken River Basin

The Broken River basin (Figure 2.), at 772,386 hectares represents 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 Lake Mokoan and flows north-west to the Murray River.

Climate varies considerably across the Broken River catchment. In the south, average annual rainfall is about 1,270 mm. This decreases to about 700 mm near Benalla, 550 mm at Dookie and 470 mm at Cobram. Across the northern section rainfall generally decreases to the west.

Most of the Broken River catchment has been cleared of native vegetation for agriculture comprising mainly 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.

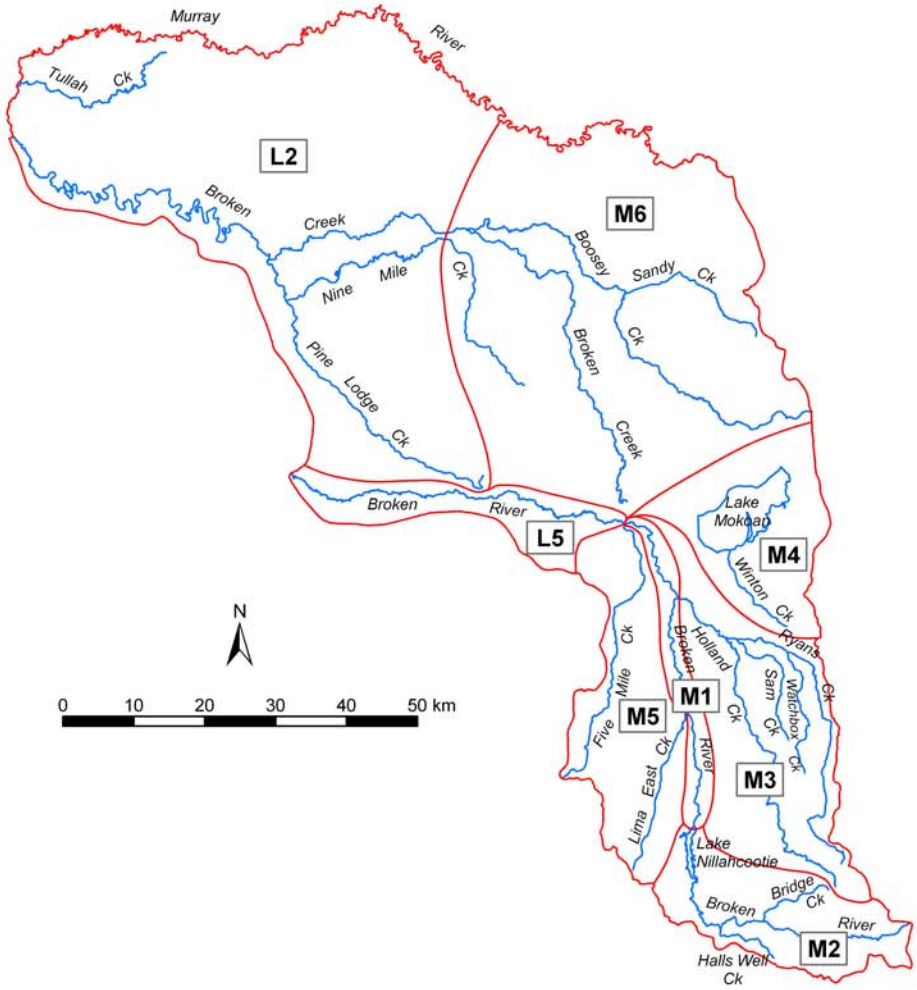
In the north of the basin a unique linear corridor exists, bordering the Broken, Nine Mile and Boosey Creeks. The area spanning 1030 hectares was proclaimed as the Broken-Boosey State Park with the passing of the Box-Ironbark Bill in 2002. The park includes streamside reserves and public land water frontages along creek system and is the only substantial occurrence of high quality native vegetation on the northern plains.

Streamflow is extremely variable between seasons and between years. The three months July to September generally account for over half the annual stream flow. The catchment has a mean annual flow of 325,000 ML (0.42 ML/hectares), however annual flow has varied from a minimum of 5,000 ML in the drought year of 1943, to maxima of more than 1,000,000 ML in the flood years of 1917 and 1956.

Two major and two smaller storages have been constructed within the catchment. Lake Nillahcootie was built in 1967 with a capacity of 40,000 ML and Lake Mokoan, constructed in 1971, has a capacity of 365,000 ML. These reservoirs provide water for stock, domestic and irrigation supplies. Two small reservoirs constructed on Ryans Creek, provide water to the town of Benalla.

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

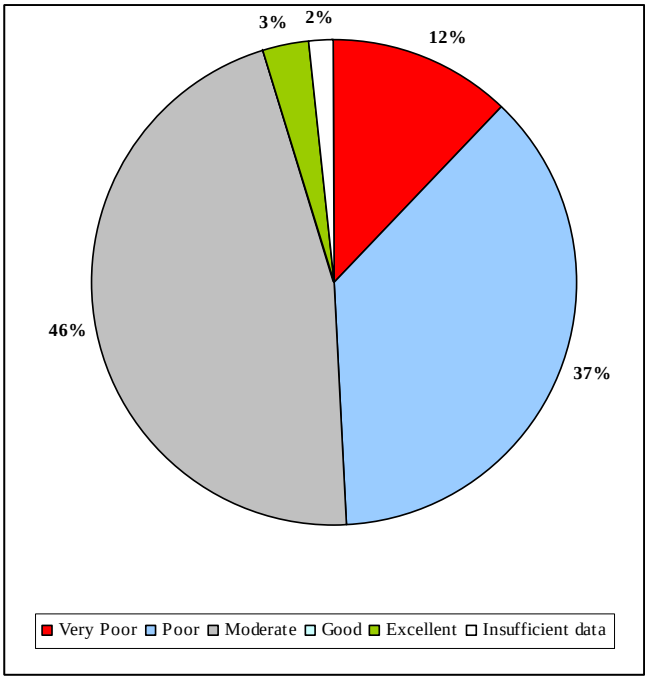
Figure 2.4. Map of the Broken Basin showing Management Units



For management and reporting purposes, the Broken River Basin has been divided into 35 separate ISC reaches and 11 different Management Units (Table 2.3). Only the main stems of the rivers in each reach are included in the length values for each Management Unit, with the total length of rivers of 778.5 km in the Broken River basin.

Table 2.3. Management Units within the Broken River Basin.

Number	Name	ISC Reaches[5]	Length (km)
L2	Lower Broken Creek	21-24, 28, 30-31	210.0
L5	Lower Broken River	1-2	62.5
M1	Mid Broken River	3-4	55.0
M2	Upper Broken River Catchment	5-6, 11-12	52.5
M3	Ryans and Hollands Creeks	13-19	127.5
M4	Lake Mokoan	20	17.5
M5	Warrenbayne Creek	7-10	63.5
M6	Upper Broken and Boosey Creeks	25-27, 29, 32-35	200.0



The 1999 Index of Stream Condition assessment (Figure 2.) showed that the majority of the Broken Catchment was rated as either Moderate (46% of the total river length) or Poor (37%) condition.

Only 3% of the total river length was classified as in Excellent condition (a single reach in upper Ryans Creek).

More details on the regional condition of rivers in the Broken catchment can be found in the accompanying report - *Regional River Health Strategy 2005-2015. Status of the Riverine System – Regional Overview*.

Figure 2.5 ISC condition for the Broken Basin

[5] Location of stream reaches can be found in the report - Regional River Health Strategy 2005-2015. Status of the Riverine System – Regional Overview

2.3 The River Murray

Although not part of the Goulburn Broken CMA region, the River Murray between Yarrawonga and Echuca lies on the border of the CMA, and is influenced by activities within the Goulburn Broken Catchment. The River Murray is internationally recognised for its significant red gum forests and wetlands. It interacts with two RAMSAR Wetlands (one of which – Barmah Forest – is directly influenced by the Broken Creek), and supports the last natural populations of Trout cod (TCRT, 2004).

The River Murray has suffered degradation of many of it's core values, and is under threat of further degradation unless positive action is taken soon to reverse this situation. Popular with recreational users who enjoy its natural beauty, camping, fishing and boating opportunities, this reach of the River Murray, is the northern border of the Catchment Management Authority Region, and supports an array of activities and interests.

Improvements to stream health in this reach will be closely linked to the health of other sections of the River such as the Hume to Yarrawonga reach upstream, and other tributaries such as the Goulburn River.

A community Action Plan has been developed for the protection and enhancement of river health for the reach of the River Murray between Yarrawonga and Echuca (Earth Tech, 2002). The development of this integrated Action Plan is the first initiative of this type in the region which sees the Murray Darling Basin Commission and river management agencies from NSW and Victoria working towards a plan for the protection and improvement of one of Australia's most valued rivers.

The Action Plan has a series of seven programs to guide management of this reach of river into the future. These are: Vegetation Management; Channel Stability; Community Engagement; Wetlands Management; Water Quality; In Stream Habitat Improvement; and Cultural and Heritage.

In 2002, the Living Murray Initiative was established as the Murray-Darling Basin Ministerial Council initiative for restoring the health of the River Murray and the Murray-Darling Basin. Under the First Step of the Initiative, significant ecological assets on the River Murray have been identified as a focus for restoration, including the Barmah-Millewa Forest, part of which lies within the Goulburn Broken Catchment.

The Goulburn Broken Regional River Health Strategy will contribute to the achievement of the vision and program goals of the Action Plan and the Living Murray Initiative.

Barmah Forest (RAMSAR Wetland)
Positioned at the confluence of the Broken Creek and River Murray

3. How We Developed the Strategy

The development of the Goulburn Broken Regional River Health Strategy has involved a range of processes and forums. Planning commenced in 2001/02 with the preparation of a range of sub-strategies and discussion papers. The production of the Regional River Health Strategy was closely aligned with the review of the Regional Catchment Strategy and its sub-strategies (GBCMA, 2002).

The requirements for a Regional River Health Strategy are outlined in the Victorian River Health Strategy (NRE, 2002). A Regional River Health Strategy primarily provides for the protection of high value areas, the maintenance of ecologically healthy rivers and the achievement of overall improvement in river health by setting river health objectives and targets which:

- clearly identify reaches which will be protected and the activities required to protect them; and
- determine the specific areas for restoration, the restoration activities required and the expected level of improvement to be achieved.
- are developed in consultation with the community and key stakeholders

The Goulburn Broken Regional River Health Strategy therefore aims to achieve four main objectives:

1. Enhance and protect the rivers that are of highest community value from any decline in condition;
2. Maintaining the condition of ecologically healthy rivers (as defined in the VRHS);
3. Achieving an 'overall improvement' in the environmental condition of the remainder of rivers; and
4. Preventing damage from inappropriate development and activities.

The Goulburn Broken Regional River Health Strategy was produced (Figure 3.1) incorporating:

- A review of relevant environmental, social and economic data from the Goulburn Broken Catchment (see Chapter 4, Appendices 2-7 and accompanying documents).
- The identification of High Priority Reaches within the Goulburn Broken catchment. These included rivers that are "of greatest value to the community", and rivers that are currently "ecologically healthy" (see Chapter 5).
- The identification of key threatening processes in High Priority Reaches, using a risk-based analysis (see Chapter 6).
- The identification of waterways within the Goulburn Broken catchment that can potentially be improved in ecological condition to ecologically healthy status, and opportunities to restore or improve environmental conditions throughout the catchment, and regulatory processes to prevent damage from inappropriate development and other activities (see Chapter 7).
- The development of Programs that form the basis of the Regional River Health Strategy to:
  - Protect and enhance rivers of highest community value (see Chapter 9);
  - Protect Ecologically Healthy Waterways (see Chapter 10);
  - Increase the number and/or length of ecologically healthy waterways (see Chapter 11);
  - Improve the environmental condition of other waterways (see Chapter 12);
  - Prevent damage from inappropriate development and activities (see Chapter 13);
  - Encourage community participation and involvement (see Chapter 14); and
  - Monitor, evaluate and report progress (see Chapter 15).

- The setting of 5 year implementation targets and 10 year resource condition targets for major river reaches and river health objectives for major river management units (see Chapter 16).

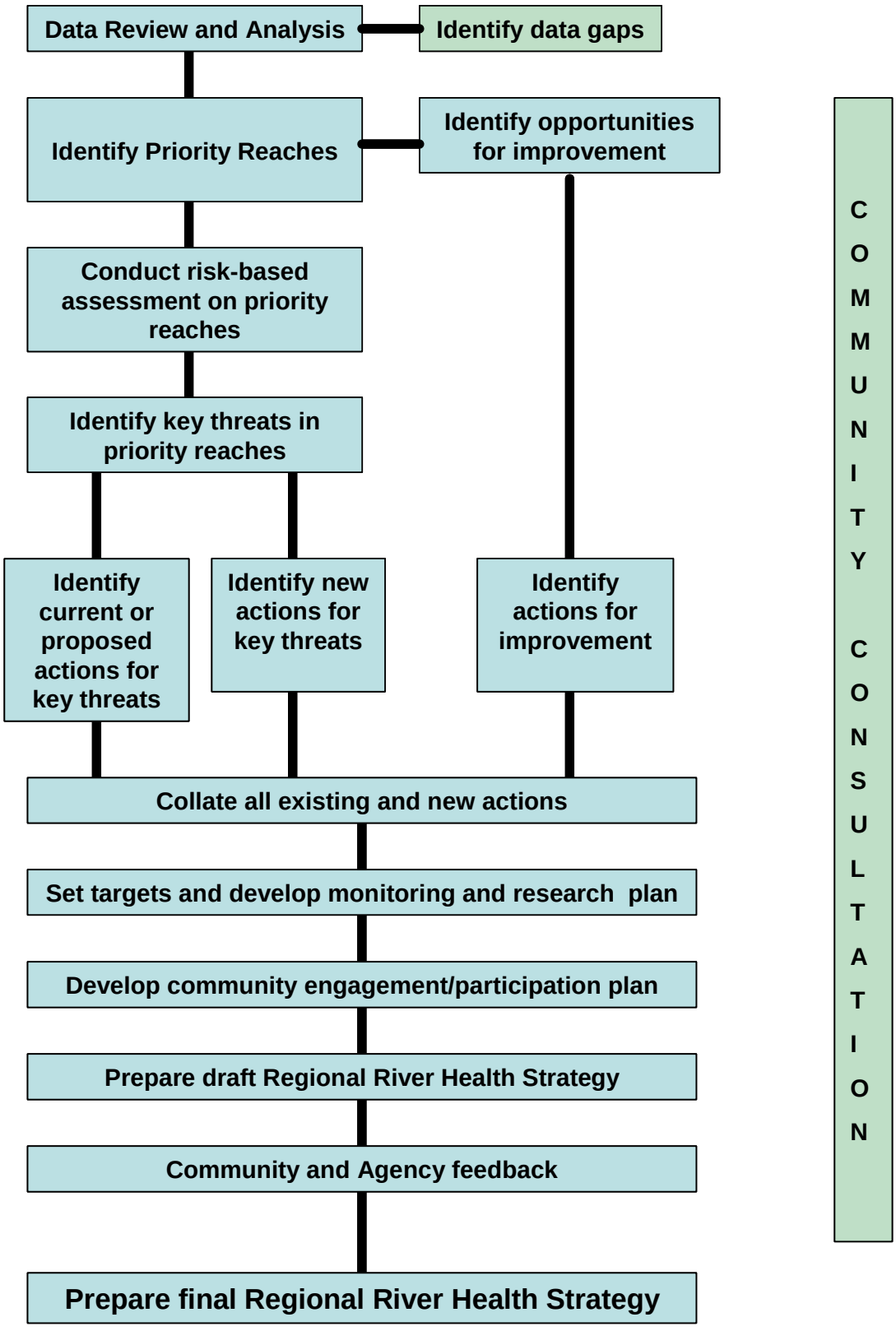


Figure 3.1. Process for developing the Goulburn Broken Regional River Health Strategy.

3.1 Community consultation

The process for developing the Regional River Health Strategy reflects the community engagement and partnership principles adopted by the GBCMA and its partners. The community was actively engaged during production of many background documents and in discussion forums used to prepare the strategy. Table 3.1 summarises steps in the process involving consultation with working groups, organisations and partners involved.

We must also be aware that engagement is ongoing, and the efforts to engage while preparing this document represent a small fraction of the overall effort. With the high amount of interest in river health in the region, it is clear that the development and implementation of this Strategy provides the CMA with significant opportunities for a range of community engagement activities (See Chapter 14).

Table 3.1 Consultative Processes and Milestones

	Goulburn Broken CMA					Regional Partners						
	CMA Board	RH&WQC	Biodiversity Committee	Implementation Committees	Waterway Working Groups	Agency and Partner Forums	Partnership Team	Commonwealth & State Agency staff	Indigenous Community	General public	Local Government	Community Groups
Establishment of three Geographic Waterway Working Groups (reporting to the Implementation Committee's)				✓	✓							
Social Study: Understanding landholder management of river frontages: the Goulburn Broken Catchment		✓		✓						✓		✓
Presentation outlining the development of a River Health Strategy	✓	✓		✓	✓		✓					
Ongoing consultation: River health issues, programs and activities										✓	✓	✓
Consultation: River Health Strategy under preparation										✓		
Consultation: What we value about streams, issues and support for management activities										✓		
Collation of environmental, social and economic data		✓		✓	✓							
Collation of values associated with river environments		✓		✓	✓	✓					✓	
Preparation of Technical, Directions and Discussion Papers[6]		✓	✓	✓			✓					
Consultation: Process for Regional River Health Strategy		✓		✓								
On-going consultation with Landcare and Community groups										✓	✓	✓
Research Forums: Providing opportunities to learn about research initiatives within their local environment.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Status of the Riverine System – "Regional Overview" and "Waterways in Focus" documents developed.		✓										
Consultation: Discussion Papers (High Value Waterways, Ecologically Healthy Waterways, Risk-based Assessment)	✓	✓		✓				✓				
Consultation: Progress Report								✓				
Development of preliminary report structure and programs		✓		✓				✓				
Feedback on progress of strategy	✓	✓		✓			✓					
Draft Report entitled "Draft for Regional and Stakeholder Comment" circulated.								✓	✓			
Draft Report (Phase 2) entitled "Draft for Regional and Stakeholder Comment" circulated.	✓	✓		✓								
Draft Goulburn Broken River Health Strategy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

The above table provides a schematic overview of key consultation milestones. The development of the Strategy has involved a process of engagement with representatives from the community, regional partners and government agencies. Representatives of stakeholder groups have been actively involved in the development and review of the strategy, through their participation and representation with the

[6] These documents are the foundation of the Regional River Health Strategy sub-strategies.

Catchment Management Authority and associated committee structures - the Implementation Committees and River Health and Water Quality Committee (See Chapter 18).

Community input through involvement in Implementation Committee and Waterway Working Group structures

Field days increases awareness and leads to future project participation and provides knowledge to the future managers of the resource.

3.2 Heritage, Cultural and Indigenous Landscape Values

The region's traditional indigenous landowners were consulted with in the development of the Regional River Health Strategy.

Representatives of three key indigenous groups – the Bangerang, Yorta Yorta and Taungurang offered to share their knowledge about indigenous history and heritage, affinity with the waterway environment, the importance of indigenous values, and involvement in the protection of those values.

Their contributions have informed the preparation of this strategy including the development of capacity building actions and opportunities for ongoing involvement in natural resource management in partnership with the Goulburn Broken Catchment.

History of Heritage and Cultural Occupation

The Yorta Yorta have been officially recognised as the traditional owners of much of the northern part of the catchment. Evidence in the form of shell middens and campsites, scar trees and artefacts point to a long history of Indigenous occupation along the Broken, Goulburn and Murray Rivers.

The Bangerang identify strongly with the same northern part of the catchment and also point to shell middens, scar trees and artefacts as evidence of Indigenous occupation. The representatives conveyed many examples of time spent in the region and a long history of association by ancestors.

The Taungurang traditional owners are asserting their native title rights over much of the southern section of the Goulburn Broken Catchment under the Commonwealth Native Title Act. They strongly affirm their ancestors lived and hunted along the Goulburn River waterways and surrounds before and shortly after European occupation. Evidence of Indigenous occupation exists in the form of burial and massacre sites, shell middens and campsite and scar trees and artefacts. Further evidence exists in some local township histories heritage documents and early census information.

Affinity with the land, waterways and wildlife

The traditional owners still feel a strong affinity with the land, waterways and local ecology.

Aboriginal people once lived in harmony with the land, managing natural resources and food in a sustainable way. Waterways and surrounding land remained a significant source of food for many indigenous people after they were moved on to missions.

Elders continued to make use of natural foods including ducks, swan eggs kangaroos, emu and food plants such as water lilies. They are strongly committed to exploring practical ways of reconnecting both their heritage and cultural practices to the land and waterways to pass on to their younger members.

Involvement in Protection of Values

The traditional owners feel frustrated in gaining access to waterways within their traditional boundaries as some present owners lock gates and run fences across Crown Land to the waters edge.

The Yorta Yorta believe traditional owners should have greater control over cultural heritage issues. All groups believe the Goulburn Broken CMA should support the traditional owners by appointing cultural officers and/or indigenous positions and traineeships within the CMA and/or by appointing support positions within Traditional Nations. This would ensure meaningful liaison with the traditional owners and assist with the organisation and dissemination of information. An environmental scientist working with the traditional owners may assist them to respond to and participate in CMA processes.

The Taungurang highlighted the need for ongoing cross-cultural training for CMA personnel. At the same time, Taungurang people who have become estranged from their culture would benefit from a cultural immersion program providing a deeper understanding of their traditional land, waterways and heritage.

They want to be consulted on land and water management issues and involved in decision making processes. They want involvement at Board level and to have their opinions and views included in policy initiatives that have implications for traditional land, water and cultural heritage values.

Concern was expressed about the timing and volume of releases down waterways. The Indigenous owners highlighted the need for the involvement of traditional owners in flow management to protect traditional food sources and the breeding cycles and spawning seasons of birds and fish. The need to preserve plant food sources was also highlighted.

Improved consultation over the creation of floodplains and works such as the removal of trees and de-snagging should occur to ensure habitat is not destroyed. The Bangerang would like to see middens and campsites in the catchment area scientifically dated and a topographical survey undertaken of the Barmah Lakes region.

The Yorta Yorta and Bangerang believe opportunities for partnerships are sometimes “lost in the translation’. All groups believe an agreement of understanding or drafting of protocols for engagement with traditional owners would assist in better communication and involvement.

4. Available Data for the Regional River Health Strategy

The main environmental, social and economic information for the Regional River Health Strategy was derived from information stored in the RiVERS database for the Goulburn Broken Basins (Heron and Sovitslis, 2004).

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. The database contains considers environmental, social and economic values and threats to those values, with data collated from existing datasets, including the Index of Stream Condition, Statewide flora and fauna databases, EPA water quality datasets and data collated by the CMAs. RiVERS enables a risk-based assessment by linking values to threats, and rating the likelihood and consequence of the threat impacting on the value.

RiVERS was developed with close consultation between the Victorian CMAs, the Department of Sustainability and Environment and Steering Committees comprising various Agencies and Institutions.

4.1 Data in the RiVERS database

The data contained in the RiVERS database is considered the best available at the time of preparation of this Regional River Health Strategy. The list of assets and threats used was developed for the VRHS, and ranking criteria for individual values and threats were developed by committees with members from the waterway management industry and Government partners.

Environmental assets (Table 4.1, Appendix 2) are divided into three types of measure, representing rarity, naturalness or representativeness. Rarity measures are those regarded as either threatened (rare or endangered flora, fauna, vegetation communities or wetlands found within 100 m of a watercourse) or have some special environmental significance (sites of significance such as Heritage Rivers). Naturalness measures assess environmental components in terms of their closeness to natural, or in some cases, acceptable condition. Representativeness is a term used in the VRHS to describe rivers or reaches that have been declared as "typical" of different bioregions across the state. The main source of environmental information came from existing databases (e.g. DSE Wildlife Atlas, Aquatic Fauna Database, Flora Database) or from the 1999 Index of Stream Condition assessments[7], although local and expert knowledge have also been incorporated.

Social assets (Table 4.1, Appendix 2) are those that have some value to the community. While some may have economic value or benefit to the region (e.g. fishing), these assets have generally been assessed in terms of frequency of use. Other social assets have no or little economic value, but represent important heritage values. The main source of social information came from local knowledge, gathered during workshops to gather specific data for inclusion in the RiVERS database.

Economic assets (Table 4.1, Appendix 2) are assessed against the financial return or value of assets to the community. Again, the majority of information in RiVERS came from local knowledge gathered through specific workshops.

[7] ISC data for the Goulburn Broken Catchment is to be reviewed in 2004. Some data may be out-of-date given the implementation of programs since 1999. For the 2004 ISC survey, some assets have new measures – such as the introduction of Habitat Hectare measures for riparian vegetation assessments – which will need to be incorporated.

Table 4.1 Assets (environmental, social and economic) and threats identified for the Goulburn Broken Catchment (see Appendices 2-5 for more detailed information).

Assets	Threats
Environmental	***Physical Threats***
Environmental significance	Bank erosion
Significant Fauna	Bank stability
Significant Flora	Channel form
Significant Ecological Vegetation Classes	Loss of instream habitat
Fish Migration	Stock access
Significant Wetlands	***Flow Threats***
Rare Wetlands	Flow deviation
Sites of Significance	Wetland connectivity
Heritage Rivers	***Water Quality Threats***
Environmental Naturalness	Water quality (trend)
Width of riparian vegetation	Water quality (physicochemical quality)
Longitudinal riparian continuity	Water quality (SIGNAL score)
Riparian structural intactness	Temperature
Aquatic invertebrate community	Algal blooms
Native fish community	***Biological Threats***
Proportion of introduced fish	Introduced flora
Ecologically Healthy River	Introduced fauna
Environmental Representativeness	Barriers to fish migration
Representative River	Degraded riparian vegetation
Social	
Recreational fishing	
Non Motor Boat sports	
Motor Boat sports	
Camping	
Swimming	
Passive Recreation	
European Heritage	
Listed landscape	
Species of Local Significance	
Economic	
Water supply – delivery	
Water supply – collection	
Infrastructure	
Land value	
Tourism	
Power generation	

Threats (Table 4.1, Appendix 3) include conditions that have the potential to have an impact on environmental, social or economic assets in the catchment[8]. These include physical conditions (e.g. bed and bank erosion), flow changes, water quality, and biological conditions (e.g. exotic flora and fauna). Much of the information came from the 1999 Index of Stream Condition assessments, but local knowledge and other sources were also used.

For each of the assets and threats, an index value between 1-5 has been assigned in each of the 110 reaches across the catchment, with higher values generally representing an increasing "value" of the asset, or an increasing level of the threat. Appendix 4 gives the rating tables for all values and threats, while Appendix 5 presents the raw data for all reaches in the Goulburn Broken Catchment.

[8] The threats included are only those that can be addressed by river management activities. While these threats are mainly to environmental assets or values, they may have impacts on social and economic assets. Threats specific to social or economic values (e.g. changes in population demographics) are not included in the Strategy.

RiVERS provides a simple method to assess the condition of assets and threats across the whole catchment, or in specific reaches within the catchment. It also allows reach prioritisation and risk-based assessments to be conducted to determine priority reaches and actions, important for the production of the Regional River Health Strategy.

Environmental data was checked by members of the Technical Panel (see page vi) and updated based on new information (e.g. new water quality and macroinvertebrate data supplied by the EPA were included). Summary environmental, social and economic information was presented to the River Health and Water Quality Committee (RHWQC – see page vi), where further updates were developed based on the members local knowledge.

5. High Priority Waterways in the Goulburn Broken

The first two objectives of the Goulburn Broken Regional River Health Strategy are to:

- Enhance and protect the rivers that are of highest community value from any decline in condition; and
- Maintain the condition of ecologically healthy rivers.

5.1 Waterways of highest community value

For the Regional River Health Strategy, reaches of the highest community value in the Goulburn Broken Catchment are identified as:

- Heritage Rivers;
- Reaches associated with International or Nationally significant wetlands;
- Reaches classified as environmental Sites Of Significance;
- Regional Representative Rivers;
- Reaches with records of water-dependant[9] nationally listed endangered flora and fauna species (under the Federal *Environment Protection and Biodiversity Conservation Act* 1999 – the EPBC Act, or AROT[10] flora) located within 100 m of the watercourse;
- Reaches classified as having high overall environmental significance;
- Reaches classified as having very high overall social value; and
- Reaches classified as having very high overall economic value.

Heritage Rivers

Heritage River corridors were identified by the Land Conservation Council (LCC, 1991). Three Heritage River corridors are listed in the Goulburn Broken Catchment.

The **Goulburn River** downstream from the Eildon Reservoir to the confluence with the Murray River near Echuca (Goulburn Basin Reaches 1-14). The heritage status of the 430 km corridor was recognised due to a number of environmental and social values, particularly:

- Areas with intact understorey in River red gum open forest/woodland, and yellow box and grey box woodland/open forest communities, particularly downstream of Murchison;
- Areas of significant habitat for vulnerable or threatened wildlife including Squirrel gliders, Large-footed myotis, Barking march frogs, Barking owls and Brush-tailed phascogales;
- Native fish diversity and Murray cod habitat below Goulburn Weir;
- Macquarie perch habitat above Goulburn Weir;
- Fishing opportunities – especially for trout from Eildon to Yea River, and native species below Goulburn Weir;
- Canoeing opportunities from Eildon to Goulburn Weir;
- Cultural heritage sites, including the timber Chinamans Bridge, the steel-girder rail bridge at Seymour, Days Flour Mill at Murchison, Goulburn Weir, and the town water supply pump at Murchison; and
- Scenic landscapes – from Molesworth to Seymour, and from below Seymour to Echuca.

[9] "Water-dependant" refers to aquatic species or those dependant on river water for survival.

[10] Australian Rare or Threatened

The **Big River** from the junction of Spring and Oaks Creek downstream to the junction with Fryer Creek (Goulburn Basin Reach 67 and lower part of Reach 68). The heritage status of the 51 km corridor was recognised due to both environmental and social values, particularly:

- Habitat for the spotted tree frog;
- Scenic landscapes along the Big River from Oaks Creek to Lake Eildon;
- Fishing opportunities, especially for trout; and
- The canoe resource in a semi-remote setting from Frenchmans Creek to Jamieson Road Bridge.

Big River (Goulburn Basin Reach 67)

The **Howqua River** from the junction of the north and south branches to Lake Eildon (Goulburn Basin Reach 69 and most of Reach 70). The heritage status of the corridor was recognised due to both environmental and social values, particularly:

- Habitat for the spotted tree frog;
- Devonian fish fossil beds;
- Fishing opportunities, especially for trout;
- Cultural heritage sites – Frys Bridge, and early settlement and mining features; and
- The canoe resource from Eight Mile Creek to Frys Hut, and the Sheepyard Flat slalom course.

Heritage River plans are currently being developed. Actions in this strategy will support and integrate with these plans.

Reaches associated with significant wetlands

Significant wetlands are defined as those listed in the Directory of Important Wetlands in Australia (Environment Australia, 2001 – Table 5.1). Apart from the Heritage Rivers identified above, 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).

Table 5.1. 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	Yes
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[11]	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	

The Regional River Health Strategy will concentrate only on conditions within the river reaches associated with the wetlands that can affect the health of the wetlands (e.g. flow, water quality, species that utilise both river and wetland habitats). The health and management of the wetlands themselves are dealt with under the Regional Wetland Strategy and Wetland Implementation Plans.

Water Management Plans are currently being prepared for Moodie, Reedy and Andersons Swamps (Kieth Ward, GBCMA, pers. comm.). Actions in this strategy will support and integrate with these plans.

Environmental Sites of Significance

Two reaches in the Goulburn Broken Catchment have been identified as environmental sites of significance – Seven Creeks Reach 19 (listed for the geological formation at Goorham Falls), and the Acheron River Reach 62 (listed for the large amount of scientific research that has been conducted in the river).

Regional Representative Rivers

Representative Rivers are selected reaches in ecologically healthy condition (or close to it) that can be seen to represent major river classes or types that occur in Victoria.

The Goulburn Broken Catchment includes four River Regions, as defined by the VRHS – Alps, North Central uplands, North Central midlands and North Central floodplains. A representative ecologically healthy river reach for three of the four River Regions has been selected (See Table 5.2 – see next section for a definition of an ecologically healthy river).

Note that none of these are Statewide representative rivers suggested by the VRHS. The representative rivers in Table 5.2 have been selected as regional examples for the Goulburn Broken Catchment.

[11] No specific reaches in the Goulburn Broken Catchment are associated with the Central Highland Peatlands.

Table 5.2. Regional Representative River reaches in the Goulburn Broken catchment.

River Region	Regional Representative River
Alps	Big River Reach 68
North Central uplands	Taggerty River Reach 64
North Central midlands	Ryans Creek Reach 17
North Central floodplains	None identified

No ecologically healthy reach has been identified in the North Central floodplains. One long-term target of the Regional River Health Strategy is to identify and raise the ecological standard of at least one reach in the North Central floodplains region to ecologically healthy status to act as a representative river.

Significant species

A number of river reaches are home to EPBC listed fauna and AROT flora considered critically dependant on stream environments. The recovery of many species is being addressed under a National Recovery Plan, Action Plan or protected through the management of threatening processes. The implementation of programs under this Regional River Health Strategy needs to support and be integrated into these efforts. (i.e. Macquarie perch, Murray cod, Barred galaxias and Spotted tree frog.) (see Appendix 14)

Sixty species of rare or threatened fauna are found within 100 m of a watercourse in the Goulburn Broken Catchment. Twelve of these species are listed under the EPBC Act (Appendix 6), and of these, six (Macquarie perch, Murray cod, Silver perch, Trout cod, Barred galaxias and the Spotted tree frog) can be considered dependant on stream environments. These 6 species have been recorded in 30 reaches across the Goulburn Broken Catchment (Table 5.3).

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 – Appendix 7). Of these, only Alpine bent could be considered as being dependant on stream environments, and so is considered to occur along high priority reaches. The only records for Alpine bent (Table 5.3) are in the upper Goulburn (Reach 16).

Table 5.3. EPBC listed fauna and AROT flora considered critically dependant on stream environments, and their location within each basin.

Taxa	Goulburn Basin	Broken Basin
Macquarie perch	15, 19, 20, 37, 51, 55	3, 4, 5, 13,14
Murray cod	1, 2, 3, 4, 5, 6, 7, 8, 37, 71	1, 2, 3, 4, 21, 22, 23
Silver perch	1, 2, 3, 4, 5, 6, 7, 8	1
Trout cod	19	
Barred galaxias	16, 64, 66	
Spotted tree frog	16, 67, 70	
Alpine bent	16	

Additionally, historical Trout cod records exist for Hughes Creek (Reach 39) in the Goulburn Basin, and the Broken River (Reach 4), Lima East Creek (Reach 9) and Ryans Creek (Reaches 16 and 17) in the Broken Basin. These records are relatively old and the species may well be extinct from these sites. One focus of the Regional River Health Strategy will be to develop plans to establish a new self-sustaining population of Trout cod in the Goulburn Broken catchment.

Trout cod may also occur elsewhere in the Goulburn Broken Catchment. Other sites in the catchment have been stocked with hatchery reared Trout cod (Hughes Creek, Ryans Creek at Loombah Weir and the Goulburn River downstream of Goulburn Weir), but the status of these populations is unknown (TCRT, 2004). Trout cod individuals, including juveniles, were recorded among victims of a fish kill at Goulburn Weir in early 2004.

A Recovery Plan is currently being prepared for Trout cod (TCRT, 2004). Actions in this strategy will support and integrate with these plans.

Reaches of very high overall environmental significance

The ranked value of each of the fifteen environmental values (Appendix 2) were summed to give an overall environmental ranking for the reach. Any reach with a total score of greater than 50 (out of a possible score of 75) was assigned to a very high overall environmental rating (Appendix 5). Six reaches in the Goulburn Basin were identified as having high overall environmental significance (Table 5.4).

Table 5.4. Reaches of very high overall environmental significance in the Goulburn Broken catchment.

Reach	Total Environmental Score
Goulburn River Reach 4	56
Goulburn River Reach 7	55
Goulburn River Reach 8	54
Taggerty River Reach 64	54
Goulburn River Reach 3	53
Goulburn River Reach 1	51

Reaches of very high overall social significance

The ranked value of each of the nine social values (Appendix 2) were summed to give an overall social ranking for the reach. Any reach with a total score of greater than 35 (out of a possible 45) was assigned to a very high overall social rating (Appendix 5). Four reaches in the Goulburn Basin were identified as having high overall social significance (Table 5.4).

Table 5.5. Reaches of very high overall social significance in the Goulburn Broken catchment.

Reach	Total Social Score
Goulburn River Reach 5	39
Goulburn River Reach 6	36
Goulburn River Reach 8	39
Goulburn River Reach 9	37

A number of other reaches scored highly on overall social score, but did not meet the criteria for "very high" rating. Twenty reaches had a total social score between 30 and 35 (Appendix 8). Significantly, nineteen of these reaches are also identified as High Priority Reaches under other criteria, so management of environmental values should also contribute to protecting or improving social values in these other reaches.

Reaches of very high overall economic significance

The ranked value of each of the six economic values (Appendix 2) were summed to give an overall economic ranking for the reach. Any reach with a total score of 24 or more (out of a possible 30) was assigned to a very high overall economic rating (Appendix 5). Three reaches in the Goulburn Basin were identified as having high overall economic significance (Table 5.4).

Table 5.6. Reaches of very high overall economic significance in the Goulburn Broken catchment.

Reach	Total Economic Score
Goulburn River Reach 14	24
Howqua River Reach 69	24
Delatite River Reach 72	24

A further twenty-four reaches had a total economic score of between 20 and 23 (Appendix 8). Significantly, twenty-one of these reaches are also identified as High Priority Reaches under other criteria, so management of environmental values should also contribute to protecting or improving economic values in these other reaches.

5.2 Ecologically Healthy Rivers

An Ecologically Healthy River is described by the VRHS as "a river which retains the major ecological features and functioning of that river prior to European settlement and which would be able to sustain these characteristics into the future". The VRHS provides a number of characteristics of an ecologically healthy river:

"An ecologically healthy river will have flow regimes, water quality and channel characteristics such that:

- in the river and riparian zone, the majority of plant and animal species are native and no exotic species dominates 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;
- native fish and other fauna can move and migrate up and down the river;
- linkages between river and floodplain and associated wetlands are able to maintain ecological processes;
- natural linkages with the sea or terminal lakes are maintained; and
- associated estuaries and terminal lake systems are productive ecosystems."

For the Regional River Health Strategy, a process was developed to identify potential Ecologically Healthy Rivers from the available data. The process is detailed in Appendix 9.

The analysis resulted in 5 reaches being identified and adopted as Ecologically Healthy Rivers, and included as High Priority Reaches for the production of the Regional River Health Strategy:

- Taggerty River (Goulburn Basin Reach 64);
- Goulburn River (Goulburn Basin Reach 15);
- Big River (Goulburn Basin Reach 67);
- Big River (Goulburn Basin Reach 68); and
- Ryans Creek (Broken Basin Reach 17).

In addition to the five reaches being identified and adopted as Ecologically Healthy Rivers, thirteen reaches were identified as being close to the criteria for ecologically healthy rivers (Appendix 9).

A focus of the Regional River Health Strategy is to improve the status of these reaches to that of ecologically healthy rivers (see Program C).

- Goulburn River (Goulburn Basin Reach 16);
- Bylands Creek (Goulburn Basin Reach 36);
- Dry Creek (Goulburn Basin Reach 48);
- Yea River (Goulburn Basin Reach 54-57);
- Murrindindi River (Goulburn Basin Reach 59);
- Acheron River (Goulburn Basin Reach 63);
- Rubicon River (Goulburn Basin Reach 65);
- Howqua River (Goulburn Basin Reach 69,70); and
- Hollands Creek (Broken Basin Reach 15);

5.3 Summary of High Priority Reaches

Forty-four High Priority Reaches can be identified in the Goulburn Broken Catchment, based on high community value and the designation of Ecologically Healthy Rivers (Table 5.7). A number of reaches have multiple high value assets. The locations of these reaches are shown in Figure 5.1 and Figure 5.2.

The primary objective of the Regional River Health Strategy is to protect and enhance the values in these High Priority Reaches (Programs A and B of the Regional River Health Strategy).

Table 5.7. Highest priority Reaches identified in the Goulburn Broken Catchment.

River	Reach	High value asset
Goulburn Basin		
Goulburn River	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16	Heritage River (1-14); Association with wetlands of national significance (1-8); High overall environmental significance (1, 3, 4, 7, 8) High overall social significance (5, 6, 8, 9) High overall economic significance (14) Murray cod (1-8); Silver perch (1-8); Macquarie perch (15); Ecologically healthy river (15); Barred galaxias (16); Spotted tree frog (16); Alpine bent (16).
Seven Creeks	19	Trout cod; Macquarie perch; Environmental Site of Significance.
Seven Creeks	20	Macquarie Perch
Gobarup Creek	33	Association with wetlands of national significance.
Hughes Creek	37	Macquarie perch; Murray cod.
King Parrot Creek	51	Macquarie perch.
Yea River	55	Macquarie perch.
Acheron River	62	Environmental Site of Significance.
Taggerty River	64	Ecologically Healthy River; Representative River; High overall environmental significance; Barred galaxias.
Rubicon River	66	Barred galaxias
Big River	67	Heritage River; Ecologically Healthy River; Spotted tree frog.
Big River	68	Heritage River; Ecologically Healthy River; Representative River.
Howqua River	69	Heritage River; High overall economic significance.
Howqua River	70	Heritage River
Delatite River	71	Murray cod.
Delatite River	72	High overall economic significance.
Broken Basin		
Broken River	1, 2, 3, 4, 5	Association with wetlands of national significance (1, 2); Murray cod; Macquarie perch (3, 4, 5) Silver perch (1).
Holland Creek	13	Macquarie perch.
Ryans Creek	17	Ecologically Healthy River; Representative River.
Broken Creek	21, 22, 23, 24, 25, 26	Association with Ramsar wetlands (21); Murray cod (21-23); Association with wetlands of national significance (22-26).

A further thirteen reaches are also considered to be a high priority following their assessment as being close to the criteria for ecologically healthy rivers (Table 5.8) .

A focus of the Regional River Health Strategy is to improve the status of these reaches to that of ecologically healthy rivers (see Program C).

Table 5.8. Highest priority Reaches - Near Ecologically Health Status.

River	Reaches	High value asset
Goulburn Basin		
Goulburn River	16	Near "Ecologically Healthy" status
Bylands Creek	36	
Dry Creek	48	
Yea River	54-57	
Murrindindi River	59	
Acheron River	63	
Rubicon River	65	
Howqua River	69, 70	
Broken Basin		
Holland Creek	15	Near "Ecologically Healthy" status

For each of these, only a single measure or group of related issues need to be improved to move the reach to ecologically healthy status[12].

In addition, the River Murray is recognised as a High Priority area for the Regional River Health Strategy. While no specific actions are developed for the River Murray, actions in this Strategy will support existing plans for the River Murray.

River	High value asset
River Murray	Internationally recognised for its significant red gum forests and wetlands; Interacts with two RAMSAR Wetlands; Popular with recreational users who enjoy its natural beauty, camping, fishing and boating opportunities; Murray cod and Trout cod.

[12] Key issues were identified from the ecologically healthy analysis (Appendix 9) and not from a risk-based assessment.

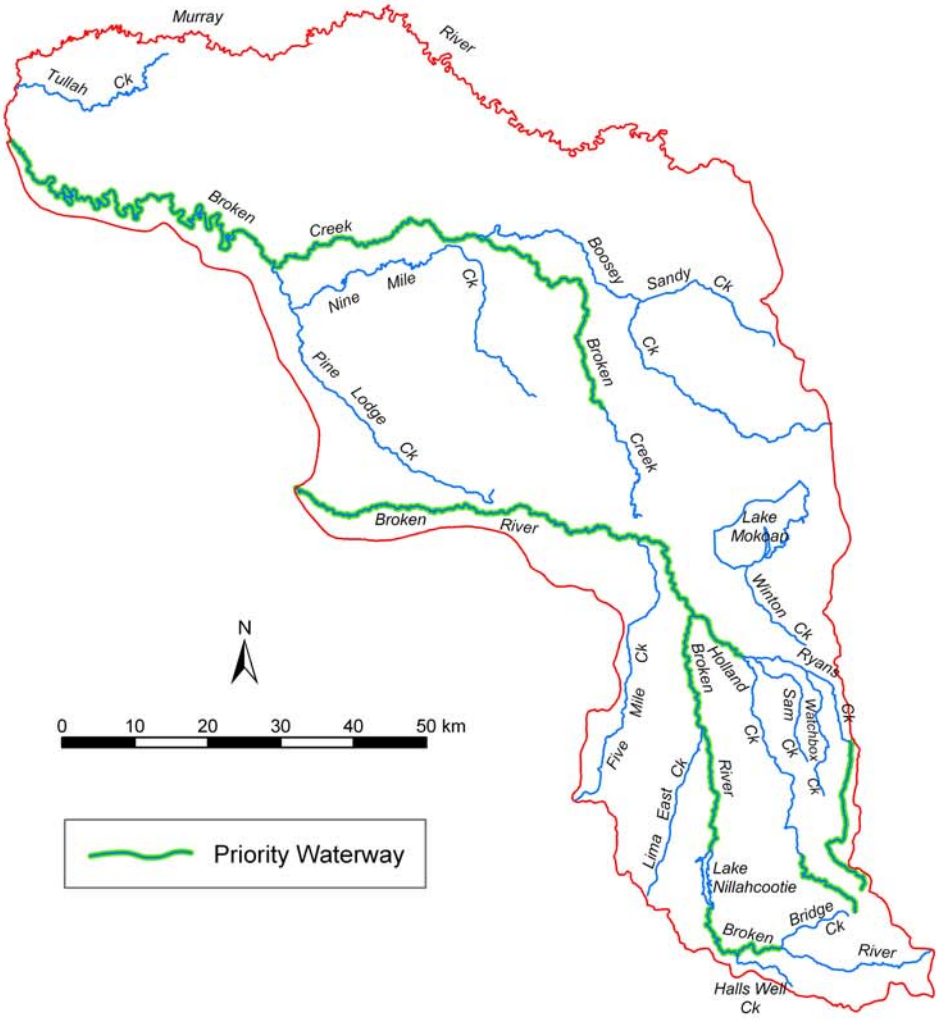


Figure 5.1. High priority reaches in the Broken Basin

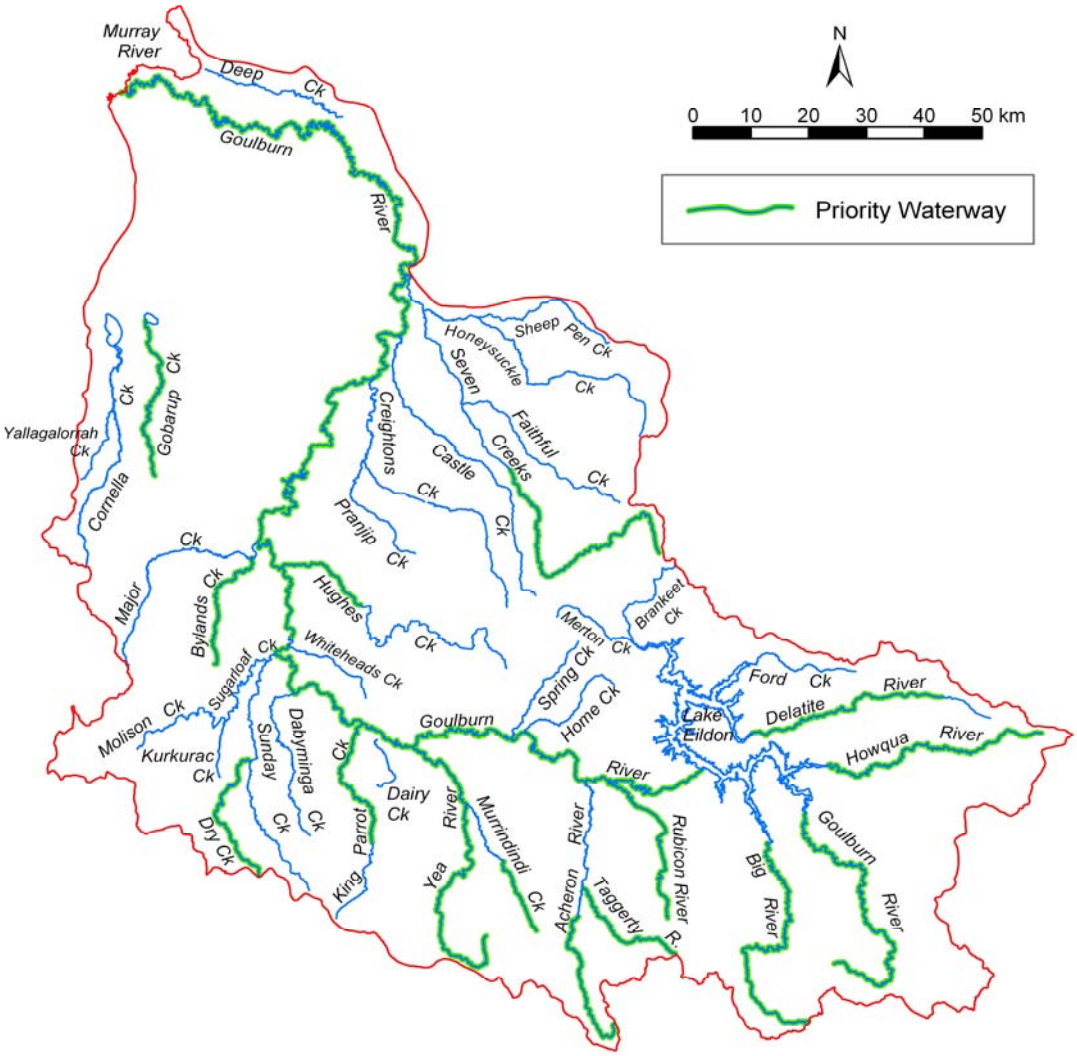


Figure 5.2. High priority reaches in the Goulburn Basin

6. Risk-based Assessment on High Priority Reaches

The aim of the risk-based assessment is to provide some objective measure of the risk to a particular asset or value (environmental, social or economic) by a particular threat. The risk-based assessment was carried out on the High Priority Reaches (Table 5.7) to identify key threats that could have a harmful impact on the high values in the waterways.

The risk-based assessment process adopted for the Goulburn Broken Catchment is outlined in Appendix 9. Basically, the assessment examines the chance (or risk) that a particular threat, if it continues to act at the present level and no actions are taken, will have an adverse impact on a particular asset or value listed in Table 4.1. The risk-based analysis is expressed as a function of "consequence" and "likelihood". This combination of consequence and likelihood (the "risk rating") represents a measure of the probability that a threat will have a serious impact on the asset.

"Consequence" is a measure of the impact that a threat can have on a particular asset or value (how severe the impact can be). This can range from no impact or only a temporary small impact, through to a catastrophic impact (e.g. complete loss of a species, or value of the asset). A generally accepted measure of consequence is the rating of the particular value. The measure of Consequence used here, therefore, is the 1-5 rating of each value (Appendix 4). That is, the higher the rating of a value, the higher the "consequence" if a threat acts on the value

"Likelihood" is a measure of the potential that a particular threat can or will have an impact on a particular value, and is a combination of the degree of threat (how seriously the threat is acting), and the association between the threat and value. The degree of each threat (Appendix 4) is taken as the 1-5 rating of each threat.

The "Association" provides an estimate of whether any physical or chemical changes that a threat would cause are likely to influence the particular value in question. Each value/threat combination has a specific association value. For a high association, there is a high probability that the threat will affect the value in every case. For example, the presence of a barrier to fish migration (the threat) has a high association with the native fish community upstream (the value) as barriers always can affect upstream fish communities.

Other value/threat combinations have lower associations – the threat may affect the asset sometimes, but not always (usually for unknown reasons). A barrier to fish migration may or may not have an impact on upstream recreational fishing opportunities (a moderate association), while the same barrier has a low association with scenic values upstream (i.e. the scenic values would be the same whether or not there is a barrier to fish migration downstream).

Association values for each value/threat combination were estimated on a 1-5 scale for each value/threat combination by the Technical Panel (see Appendix 10).

For the purposes of the Regional River Health Strategy, different combinations of association, consequence and threat levels were determined to have various degrees of risk, which can then be associated with specified management responses (Table 6.1). The risk ratings adopted for the Goulburn Broken catchment are:

- **Very High**: This risk rating has the highest priority for a management response, with an urgent need to reduce the level of the threat to protect the asset.
- **High**: This rating suggests that threat reduction should be a high priority (but less than for a Very High risk threat).

- **Medium 1**: Under the Medium 1 risk rating, there is some elevated chance that the value may be affected. If possible, threat reduction should be considered, but the value should at least be monitored to detect any future decline.
- **Medium 2**: Under Medium 2 rating, it may not be necessary to immediately reduce the level of threat (as the threat level is already only moderate). However, the value should be monitored to detect any future decline, and the threat should not be allowed to increase in severity.
- **Low 1**: Under a Low 1 risk rating, the immediate risk to the asset is low, but any increase in the threat level is potentially serious (so the management response is to prevent an increase in the level of threat).
- **Low 2**: Low 2 risk ratings suggest that the threat may have already had an impact on the value. These should be examined on a case-by-case basis to confirm any causal link. Reducing the threat level could therefore be appropriate to increase the value.

Table 6.1. Combinations of association, consequence and threat values associated with levels of risk and management responses (see Appendix 9 for more details).

Risk Rating	Association	Consequence	Threat	Management Response
Very High	5	5	5	Urgent need to reduce threat level. Top priority for threat reduction.
High	5 or 4	5 or 4	5 or 4	High priority for threat reduction
Medium 1	3	4 or 5	4 or 5	Monitor asset level for decline; Opportunistic threat reduction.
Medium 2	4 or 5	4 or 5	3	Monitor asset level for decline; Do not allow an increase in threat level.
Low 1	4 or 5	4 or 5	1 or 2	Do not allow an increase in threat levels
Low 2	4 or 5	1 or 2	4 or 5	Assess whether threat is the cause of low value and act accordingly.

6.1 Risk Ratings in High Priority Reaches

The risk-based assessment was conducted for all combinations of threat and value in each High Priority Reach in the Goulburn Broken Catchment. For each of the identified high value assets (Table 5.7), the risk to that asset by the various threats in the catchment are evaluated according to the criteria in Table 6.1.

A full set of risk ratings for all values and all High Priority Reaches in the Goulburn Broken Catchment can be found in Appendix 11.

Table 6.3 and Table 6.2 present a summary of Very High (VH), High (H) and Medium (M) risk ratings in each of 29 High Priority Reaches – only summaries are given for Management Unit L1 (Goulburn River from Goulburn Weir to the Murray River) and Management Unit U1 (Goulburn River from Eildon Reservoir to Goulburn Weir) as many of the high risk threats were similar throughout each of these Management Units. Risk ratings from individual reaches in Management Units L1 and U1 are shown in Appendix 11.

The threats identified with Very High, High and Medium risk ratings have the potential to seriously affect the important environmental, social and/or economic values identified in the High Priority Reaches. The primary aim of the Goulburn Broken Regional River Health Strategy is to reduce the level of these threats in order to protect the values.

Table 6.2. Risk ratings for each threat in High Priority Reaches in the Goulburn Basin

		Goulburn River: Goulburn Weir to Murray River	Goulburn River: Eildon Res. to Goulburn Weir	Seven Creeks	Seven Creeks	Gobarup Creek	Hughes Creek	King Parrot Creek	Yea River	Acheron River	Taggerty River	Rubicon River	Goulburn River: u/s of Eildon Res.	Goulburn River: lower u/s of Eildon Res. upper	Big River lower	Big River upper	Howqua River lower	Howqua River upper	Delatite River	Delatite River
	Reach Number	L1	U1	19	20	33	37	51	55	62	64	66	15	16	67	68	69	70	71	72
	Threat																			
Physical Threats	**Bank erosion**	H	VH					M2											M2	
	Bed instability		VH	M2															H	M1
	Channel modification	H	M2		M2															
	Loss instream habitat	H	VH	M2			M2			VH										
	Stock access	VH	VH	VH	VH	M1	VH	VH	VH	H									VH	
Flow Threats	**Flow deviation**	VH	VH					M2				VH								
	Wetland connectivity	VH**																		
Water Quality Threats	**Water quality**	VH		VH	VH															
	Water quality SIGNAL	VH	VH	VH				VH											M2	
	Water quality trend	H	H		H								H			H			H	
	Temperature		VH																	
	Algal blooms		VH																	
Biological Threats	**Introduced flora**	M2	VH	M2			M2	M2					M2	VH					H	
	Introduced fauna	M2		M2	M2					M2										
	Fish barriers		VH	M2	M2		VH	H	H		H								VH	
	Degraded riparian veg		VH	M2	M2									H					H	

** - Reach 1 only

Key: VH – Very High; H – High; M1 – Medium 1; M2 – Medium 2 (see Table 6.1 for explanation).

Table 6.3. Risk ratings for each threat in High Priority Reaches in the Broken Basin

		Broken River	Broken River	Broken River	Broken River	Broken River	Holland Creek	Ryans Creek	Broken Creek	Broken Creek	Broken Creek	Broken Creek	Broken Creek	Broken Creek
	Reach Number	**1**	**2**	**3**	**4**	**5**	**13, 14**	**17**	**21**	**22**	**23**	**24**	**25**	**26**
	Threat													
Physical Threats	**Bank erosion**										M2			
	Bed instability	M2	M2											
	Channel modification	M2	M2	H	H	H	H							
	Loss instream habitat	M2				M2				M2				
	Stock access	H	H	VH	VH	VH	VH		VH	H	VH	M1	M1	M1
Flow Threats	**Flow deviation**	VH	VH	VH	VH		M2		VH	VH	VH	H	H	H
	Wetland connectivity								M2					
Water Quality Threats	**Water quality**	H	nd	H	VH		VH		VH	nd	nd	nd	H	
	Water quality SIGNAL	nd	H	H		VH						nd	H	H
	Water quality trend	nd	nd	H	H		VH		H	nd	nd	nd	H	
	Temperature			H	H									
	Algal blooms													
Biological Threats	**Introduced flora**	M2	M2	M2	M2	H	M2				M2		M2	M2
	Introduced fauna	M2	M2						M2	M2	M2	M2	M2	M2
	Fish migration barriers		VH	VH	VH	VH	VH							
	Degraded riparian vegetation				M2	H	M2		M2	M2	M2			

Key: VH – Very High; H – High; M1 – Medium 1; M2 – Medium 2 (see Table 6.1 for explanation).

nd – no water quality data available, but likely to be a risk, due to results in surrounding and upstream reaches.

7. Opportunities for improvement and preventing damage from other activities

This section addresses one of the two remaining objectives of the Regional River Health Strategy:

- To achieve an 'overall improvement' in the environmental condition of the remainder of rivers; and
- Preventing damage from inappropriate development and activities.

7.1 Achieving overall improvements

Achieving an overall improvement in the environmental condition of the high non-priority rivers and reaches can be addressed in a number of ways. Specific non-priority reaches may be selected for their potential to improve environmental ratings, or specific threats can be managed. In particular, by:

- Improving the condition of rivers or reaches that are near to ecologically healthy river status;
- Identifying specific environmental objectives for other reaches; and/or
- Identifying broad scale threats to a number of different assets that can easily be addressed within current sub-strategy actions.

Near Ecologically Healthy Rivers

Thirteen reaches were identified as being close to the criteria for ecologically healthy rivers (Table 7.1, Appendix 9). For each of these, only a single measure or group of related issues need to be improved to move the reach to ecologically healthy status[13].

A focus of the Regional River Health Strategy is to improve the status of these reaches to that of ecologically healthy rivers (see Program C).

Table 7.1. Reaches identified as near ecologically healthy status

River	Reaches	Key issues
Goulburn Basin		
Goulburn River	16	Poor riparian width and continuity, exotic vegetation.
Bylands Creek	36	Poor in-stream habitat.
Dry Creek	48	Poor in-stream habitat.
Yea River	54-57	Poor riparian width and continuity, stock access.
Murrindindi River	59	Poor riparian width and continuity.
Acheron River	63	Poor riparian width, stock access.
Rubicon River	65	Poor riparian width and continuity, stock access.
Howqua River	69, 70	Poor riparian width.
Broken Basin		
Holland Creek	15	Poor riparian width.

Extension of range of Trout cod

Currently, breeding populations of Trout cod (listed as Critically Endangered under the EPBC Act) are only found in one reach in the Goulburn Broken catchment, Seven Creeks Reach 19.

[13] Key issues were identified from the ecologically healthy analysis (Appendix 9) and not from a risk-based assessment.

A challenge for the Regional River Health Strategy is to provide suitable secure habitat for the species in Seven Creeks, but a further challenge is to rehabilitate new sites to enable stocking or translocation of a new sustainable population of Trout cod.

Historical Trout cod records exist for Hughes Creek (Reach 39) in the Goulburn Basin, and the Broken River (Reach 4), Lima East Creek (Reach 9) and Ryans Creek (Reaches 16 and 17) in the Broken Basin. Some sites in the catchment have been stocked with hatchery reared Trout cod (Hughes Creek, Ryans Creek at Loombah Weir and the Goulburn River downstream of Goulburn Weir), but the status of these populations is unknown (TCRT, 2004).

In line with the Trout cod Recovery Plan, investigations will be conducted to ascertain the best sites in the catchment for stocking or translocation (see Chapter 17).

Broad scale threats

The previous sections are aimed at addressing threats to specific environmental values. Opportunities exist throughout the Goulburn Broken Catchment to improve environmental conditions by encouraging landholders to tackle major broad scale threats to high riverine values.

The RiVERS risk assessment was used to identify where individual threats had the widest impact on environmental values. All instances of high value environmental assets, as well as the social value of locally significant species, in non-priority reaches (all reaches not addressed above) were identified. For each of these high value assets, threats that constitute a Very High or High risk to these high value assets were also identified. Table 7.2 shows the number of times each threat had a Very High and High risk to particular high value assets across all non-priority reaches.

In this table, the number indicates the number of non-priority reaches that have a high value environmental asset where the particular threat has a Very High or High risk. For example, there are 41 non-priority reaches that have significant EVCs where stock access represents a Very High risk to those EVCs. And in 7 non-priority reaches that have significant faunal values, introduced vegetation represents a High risk to those faunal values.

This clearly shows that, across all environmental values, stock access, degraded streamside zone and introduced flora either affect the largest number of environmental values, and/or are a Very High or High risk threat in the most number of non-priority reaches.

Hence, addressing these threats across the catchment in non-priority reaches would seem to be the best strategy for protecting or improving the most number of environmental values in the Goulburn Broken Catchment (see Program D).

Table 7.2(a) Number of non-priority reaches with Very High risk threats to significant values.

Very High Risk to value		Invertebrate O/E	Significant EVC	Significant fauna	Native fish O/E	Native fish proportion	Significant flora	Longitudinal Continuity	Riparian structural intactness	Wetland rarity	Riparian width	Species of local significance
Physical Threats	Bank erosion											1
	Bed instability											
	Channel form											
	instream habitat	1		4								1
	Stock access		41	40			2	5	2		2	6
Flow Threats	Flow deviation		3	3								1
	Wetland connectivity											6
Water Quality Threats	Water quality											
	Water quality SIGNAL	1		2								1
	Water quality trend	6		7								5
	Temperature											
	Algal blooms											
Biological Threats	Introduced flora											1
	Introduced fauna											
	Barriers			3	2							2
	Degraded riparian veg		2									

Table 7.3(b) Number of non-priority reaches with High risk threats to significant values.

High Risk to value		Invertebrate O/E	Significant EVC	Significant fauna	Native fish O/E	Native fish proportion	Significant flora	Longitudinal Continuity	Riparian structural intactness	Wetland rarity	Riparian width	Species of local significance
Physical Threats	Bank erosion	1	1	1					2			1
	Bed instability	1		2		1						3
	Channel form			2								1
	instream habitat	3		7	4	1						9
	Stock access	12	3	3	8		4	1	29		3	32
Flow Threats	Flow deviation		1				1		2			2
	Wetland connectivity											
Water Quality Threats	Water quality	2		2	1				1			3
	Water quality SIGNAL	1			1				1			2
	Water quality trend								6			1
	Temperature											
	Algal blooms											
Biological Threats	Introduced flora	4	5	7				2	2	3		5
	Introduced fauna											
	Barriers			9	3	2						8
	Degraded riparian veg	7	3	5	4	2			11			14

7.2 Preventing damage from inappropriate development and other activities

Many activities in a catchment have the potential to influence river health. Activities such as water extraction, urban development, grazing or cropping on the river bank, and the disposal of wastewater all degrade various aspects of river condition. While these have distinct social and economic benefits for the region, it is essential that they are controlled in such a way that the impact on river health is minimised. A number of agencies have a key role in regulating development along streams as part of their normal activities.

A real challenge in the Goulburn Broken Catchment is to ensure co-ordination between agencies so that river health is an important component of decision making. Referrals between agencies on specific development issues are an important part of managing river health.

Tied in with this is the need for continuing education for agency staff in river health issues. Environmental knowledge is growing all the time and up-to-date information on river health ideas is critical for long-term protection and improvement of river health.

Many agencies are involved in activities that, while not directed at managing river health, may have impacts of the condition of rivers and streams, such as fire management and road maintenance (see Program E).

Also important for preventing future damage is the development and adoption of guidelines, Codes of Practice and Current Recommended Practice for various catchment activities. Appendix 12 provides a list of these that have been developed for the Goulburn Broken Catchment.

8. Goulburn Broken Regional River Health Strategy - The Programs

The Goulburn Broken Regional River Health Strategy will be delivered in seven separate programs, targeting the four key elements outlined in the Strategy development, as well as monitoring and research, and community engagement. Management Units and Reaches[14] referred to in these programs can be identified from Figure 2.1 and Figure 2.3.

Program A – Protection and Enhancement of High Priority Reaches[15]

Program A addresses key threats in forty-three reaches in the Goulburn Broken catchment identified as High Priority Reaches (those of high community value for environmental, social and economic values). The High Priority Reaches are grouped into Management Units.

Program B – Protection of Ecologically Healthy Rivers[13]

Program B protects existing assets in the five river reaches identified as ecologically healthy waterways from any future threats to the ecologically healthy status.

Program C – Creating More Ecologically Healthy Rivers

Program C targets the thirteen reaches have been identified as approaching ecologically healthy river status that can relatively simply be improved to ecologically healthy status.

Program D – Improvements to other reaches

Program D focuses on achieving an 'overall improvement' in the environmental condition of rivers not identified as high priority, through broad scale riparian vegetation improvements.

Program E – Preventing damage from inappropriate development and other activities

Program E identifies regulatory controls on developments that can affect river health and proposes co-ordination between agencies to maximise efficiencies to deliver river health outcomes.

Program F – Community Engagement and Building Capacity

Program F identifies actions to ensure that local communities are fully engaged and committed through their participation and capacity to become involved.

Program G – Monitoring, Evaluating and Reporting

Program G outlines the requirements for monitoring progress of the River Health Strategy in achieving the objectives of the Strategy and the targets of the individual actions.

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[14] A number of river reaches are home to EPBC listed fauna and AROT flora considered critically dependant on stream environments. The recovery of many species is being addressed under a National Recovery Plan, Action Plan or protected through the recognition and management of threatening processes. The implementation of programs under this Regional River Health Strategy needs to support and be integrated into these efforts (see Appendix14).

[15] Appendix 11 presents further detail of the priority assets within each High Priority reach in the Goulburn Broken Catchment. .

9. Program A: Protection and Enhancement of High Priority Reaches

9.1 Management Unit L1 – Lower Goulburn River and Floodplain (Goulburn Basin Reaches 1-8)

Management Unit L1 – Lower Goulburn and Floodplain – covers the Goulburn River downstream of Goulburn Weir, a total length of stream of 195 km. Eight separate reaches form the Management Unit (all of which form High Priority Reaches).

River	ISC Reaches	High Values to be protected
Goulburn River	1 - 8	Heritage River; Association with wetlands of national significance; Murray cod; Silver perch.

Heritage River values in Management Unit L1 are based on a number of different values: River red gum open forest/woodland, and yellow box and grey box woodland/open forest communities, significant habitat for vulnerable or threatened wildlife, native fish diversity and Murray cod habitat, fishing opportunities for native species, European cultural sites, and scenic landscapes from Nagambie to Echuca.

A number of threats have consistent high risk ratings throughout the Management Unit, so environmental management should be dealt with on a Management Unit level, rather than at an individual reach level[16]. Individual reach risk assessment results are found in Appendix 10. Actions to address these threats are outlined in Table 9.1.

Threats identified to high value assets in Management Unit L1

MU	Very High Risk to values	High Risk to values	Medium Risk to values
L1	Flow deviation Wetland connectivity (Reach 1 only) Stock access Water quality SIGNAL, Water quality (nutrients, turbidity)	Channel modification Bank erosion Loss of instream habitat Water quality trend (pH, EC)	Introduced flora (M2) Introduced fauna (M2)

[16] Risk rating taken as the maximum rating for any particular threat throughout the Management Unit.

Table 9.1 Actions and targets in Management Unit L1 – Lower Goulburn and Floodplain – under the Regional River Health Strategy

No	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Programs
Very High Risk to Assets							
L1.1	Flow deviation	Complete Goulburn environmental flow project, undertake economic assessment of improved river health, and implement recommendations with negotiated environmental flow regimes by 2010. Implementation of Action 3.9 (Our Water, Our Future to meet commitment to Living Murray project)	DSE DSE	50 (link to L5.2)	Goulburn environmental flow project completed and negotiated environmental water reserve.	Establish Environmental Water Reserve and improved environmental flow regimes for 8 high value river reaches currently flow stressed.	*Flow Management Plan, Fisheries Management Plan, Aquatic and native riparian Flora and Fauna program*
L1.2		Review Bulk Entitlement for Goulburn River as part of Victoria's contribution to the Living Murray process	DSE, CMA	50	Bulk Entitlement Reviewed and amended as appropriate		*Flow Management Plan*
L1.3		Review the operating procedures of Goulburn Weir with a view to optimising water levels for the protection of the aquatic ecosystem.	GMW, CMA, DSE	10	Operating procedures reviewed and amended as appropriate.		*Flow Management Plan*
L1.4	Wetland connectivity	Implement Lower Goulburn Floodplain management plan (Reach 1 only)	CMA	25,000	Enhance floodplain to river linkages over 30 km of stream.	ISC Wetland connectivity rating improved by 2 points over 30 km of river in Reach 1.	*Wetlands Strategy*
L1.5	Stock access	Provide fencing and revegetation incentives.	CMA	368	40 km frontage fenced and revegetated with native species	Improve ISC Streamside Zone sub-index by up to 8 points over 98 km river; Improve ISC Physical Form sub-index by up to 1 point over 98 km river.	*Waterway Management and Implementation Plan*
L1.6		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	390 km frontage under CRP		*Water Quality strategy*
L1.7		Control grazing on public waterfronts	CLM, Parks	Program E	390 km frontage controlled		*Licensed Grazing (Public Land)*
L1.8	Water quality (Nutrients)	Provide fencing and revegetation incentives in Management Unit L1, and tributaries of Management Units L3 (Euroa Strathbogie) and L5 (Lower Broken River) and U3 (Sunday/Dry Creeks – South West Goulburn) and other priorities identified through SEDNET modelling.	CMA	5,014 plus L1.5	585 km frontage fenced, as: 40 km frontage fenced (L1); 420 km frontage fenced (L3 and U3); 125 km frontage fenced (L5).	Reduction in phosphorous exports of 2375 kg/year[17] at Gauge 405204	*Waterway Management and Implementation Plan*
		Investigate the implementation of key recommendations from Goulburn River Audit (2005)	CMA, EPA, GMW, GVW, DSE, DP	TBD	TBD	TBD	*TBD*

[17] Based on a reduction of 2.5 kg/km/yr total phosphorous due to fencing and revegetation (see Assumptions in Appendix 14).

L1.9		Minimise nutrient run-off into irrigation drains by implementation of on-farm BMP by irrigators as outlined in the Irrigation Drainage Program of the Water Quality Strategy	GMW, DPI	60,000[18]	Programs implemented as determined.	Contribute to reduction in phosphorous exports of 84.5 tonnes per year from the Shepparton Irrigation District.	*Water Quality Strategy*
L1.10		Remove phosphorous from irrigation drains through water re-use, sediment removal and nutrient stripping, as outlined in the Irrigation Drainage Program of the Water Quality Strategy.	GMW, DPI				
L1.11		Minimise nutrient discharge to rivers by reducing nutrient generation to wastewater facilities, and from wastewater sources by disposal to land and/or improved treatment.	Urban Water Authorities	0[19]		Contribute to 80% reduction below 1996 levels in total phosphorous exports from wastewater facilities.	
L1.12		Implement BMP for urban drainage as outlined in the Urban Stormwater Management Program of the Water Quality Strategy.	Local shires	3,140[20]		Contribute to reduction in phosphorous exports of 2.85 tonnes per year from the Shepparton Irrigation District.	
L1.13	Water quality (turbidity)	Stabilise near stream erosion using appropriate methods.	CMA	300	Banks stabilised over 65 km of stream	Reduction in fine and coarse sediment exports of 3900 tonnes per year[21]	*Waterway Management and Implementation Plan*
L1.14		Provide fencing and revegetation incentives in Management Unit L1, and tributaries of Management Units L3 (Euroa Strathbogie) and L5 (Lower Broken River).	CMA	See L1.8	935 km frontage fenced and revegetated (see L1.8)		
L1.15		Conduct an Ecological Risk Assessment in Management Unit L1 for turbidity, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	30	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*
High Risk to Assets							
L1.16	Water quality trend (pH, EC)	Conduct an Ecological Risk Assessment in Management Unit L1 for pH and EC, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	See L1.15	Ecological Risk Assessment conducted	As determined by Risk Assessment.	*Water Quality Strategy*
L1.17	Loss of in-stream habitat	Enhance Aquatic Refugia to protect instream habitat (protection zones)	CMA	2,850	142.5 km of river with habitat improvement works	Improvement in ISC Physical Form sub-index by 1 points over 71.7 km of river in Reaches 1-6.	*Waterway Management and Implementation Plan*
L1.18	Channel modification		CMA				

[18] Cost of actions throughout the Shepparton Irrigation District.
[19] As in the Water Quality Strategy, wastewater management actions have not been costed, as these will be implemented independent of the Regional River Health Strategy .
[20] Includes actions in tributaries to Management Unit L1.
[21] Based on a reduction of 60 t/km/yr fine and coarse sediment due to bank stabilisation.

L1.19	Bank erosion	Stabilise near stream erosion using appropriate methods.	CMA	See L1.14	Banks stabilised over 65 km of stream	Improvement in ISC Physical Form sub-index by 1 points over 32.5 km of river.	*Waterway Management and Implementation Plan*
L1.20		Encourage land managers to adopt CRP for "*Stabilising bed and banks"*.	DSE, CMA	Program F	65 km of stream under CRP		*Water Quality strategy*
Medium Risk to Assets							
L1.21	Introduced flora	Control exotic vegetation on streams and revegetate with native species	CMA	40	40 km of stream subject to riparian weed control	ISC Streamside Zone sub-index improved by up to 7 points over 20 km of river in Reaches 3 and 5.	*Waterway Management and Implementation Plan*
L1.22		Monitor assets in Reaches 3 and 5 at risk from exotic vegetation - Significant EVC (box woodland), Wetland condition, Murray cod and develop actions to reduce threat if assets decline.	CMA	Program G	Monitoring program implemented (see Chapter 15)	No decline in condition of assets.	*Monitoring, Evaluation and Reporting Program* to be developed
L1.23	Introduced fauna	Support actions within the Murray Darling Basin Native Fish Management Strategy	CMA	Costed under MDBC Strategy	Control and manage introduced species	Contribute to an overall enhancement of stream health and water quality	*Murray Darling Basin Native Fish Management Strategy*

Rather than identify further actions to reduce the threat posed by turbidity (apart from actions also designed to address other threats), pH and EC, an Ecological Risk Assessment will be undertaken to further investigate the seriousness of the threat to the significant assets. The Ecological Risk Assessment will develop additional priority actions within the waterway if appropriate. Further, the assessment will set realistic Resource Condition Targets if appropriate. It may not be realistic to expect that the water quality objectives outlined in the SEPP Waters of Victoria can be met in some reaches, or that the timeframe to achieve the water quality objectives is within the life of this Strategy. The assessment will therefore identify appropriate targets and timeframes.

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit L1

Threat	High Value Assets Protected
Flow Deviation	Riparian vegetation, Wetland rarity, Flagship species, Motor boating, Camping, Fishing.
Wetland Connectivity	Wetland rarity, Flagship species.
Stock Access	Wetland rarity, Riparian vegetation, Flagship species, Camping, Fishing, Water supply delivery.
Water Quality	Wetland rarity, Flagship species, Fishing, Water supply delivery

9.2 Management Unit L2 – Lower Broken Creek (Broken Basin Reaches 21-24, 28, 30 and 31)

Management Unit L2 – Lower Broken Creek – covers the lower sections of Broken Creek downstream of Katamatite, as well as all of Pine Lodge Creek and the lower reach of Nine Mile Creek. The total length of stream in the Management Unit is 210 km. Seven reaches have been identified in the Management Unit, of which the four reaches in the Broken Creek have been identified as High Priority Reaches.

River	ISC Reaches	High Values to be protected
Broken Creek	21-24	Association with Ramsar wetlands (Reach 21); Murray cod (Reaches 21-23); Association with wetlands of national significance (Reaches 22-24). Broken-Boosey State Park - unique linear corridor, substantial occurrence of high quality native vegetation

A number of threats to high value assets have been identified in each reach. Actions to address these threats are outlined in Table 9.2.

Threats identified to high value assets in Management Unit L2

Reach	Very High Risk to values	High Risk to values	Medium Risk to values
21	Flow deviation Stock access Water quality (Nutrients, turbidity)	Water quality trend (pH, turbidity, Total phosphorous)	Wetland connectivity (M2) Degraded riparian vegetation (M2) Introduced fauna (M2)
22	Flow deviation	Stock access	Loss of in-stream habitat (M2) Degraded riparian vegetation (M2) Introduced fauna (M2)
23	Flow deviation Stock access		Bank erosion (M2) Introduced flora (M2) Degraded riparian vegetation (M2) Introduced fauna (M2)
24		Flow deviation	Stock access (M1) Introduced fauna (M2)

Table 9.2 Actions and targets in Management Unit L2 – Lower Broken Creek – under the Regional River Health Strategy

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Very High Risk to Assets							
L2.1	Flow deviation	Develop a Flow Rehabilitation Plan (Broken Creek). Implement Broken Creek environmental flow project, undertake risk analyses of values, threats and mitigation measures, and implement negotiated environmental flow regimes.	CMA	100 (TBD)	Broken Creek environmental flow project completed and negotiated environmental water reserve.	Improved environmental flow regimes for 4 high value river reaches currently flow stressed.	*Flow Management Plan, Aquatic and native riparian Flora and Fauna program*
L2.2		Co-ordinate management of Rice's Weir and associated fishway with environmental water requirement of Goose's Swamp.	CMA	20			
L2.3	Stock access	Provide fencing and revegetation incentives in Broken Creek Reaches (21-24).	CMA	2,254	245 km frontage fenced	Improve ISC Streamside Zone sub-index by up to 8 points over 62 km river. Improve ISC Physical Form sub-index by up to 1 point over 62 km river.	*Waterway Management and Implementation Plan*
L2.4		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	245 km frontage under CRP		*Water Quality strategy*
L2.5		Control grazing on public waterfronts	DSE (CLM)	Program E	245 km frontage controlled		*Licensed Grazing (Public Land)*
L2.6	Water quality (Nutrients)	Provide fencing and revegetation incentives in Management Unit L2, and Pine Lodge and Nine Mile Creek tributaries	CMA	1,610 plus L2.3	420 km frontage fenced as: 245 km frontage fenced (Broken Creek); 60 km frontage fenced (Nine Mile Creek); 115 km frontage fenced (Pine Lodge Creek).	Reduction in phosphorous exports of 1050 kg/year[22] at Gauge 404210	*Waterway Management and Implementation Plan*
L2.7		Minimise nutrient run-off into irrigation drains by implementation of on-farm BMP by irrigators as outlined in the Irrigation Drainage Program of the Water Quality Strategy	GMW, DPI	See L1.10, L1.11	Programs implemented as determined.	Contribute to reduction in phosphorous exports of 84.5 tonnes per year from the Shepparton Irrigation District.	*Water Quality Strategy*
L2.8		Remove phosphorous from irrigation drains through water re-use, sediment removal and nutrient stripping, as outlined in the Irrigation Drainage Program of the Water Quality Strategy.	GMW, DPI				
L2.9		Minimise nutrient discharge to rivers by reducing nutrient generation to wastewater facilities, and from wastewater sources by disposal to land and/or improved treatment.	Urban Water Authorities	See L1.13		Contribute to 80% reduction below 1996 levels in total phosphorous exports from wastewater facilities.	
L2.10	Water quality (turbidity)	Provide fencing and revegetation incentives in Management Unit L2, and Pine Lodge and Nine Mile Creek tributaries	CMA	See L2.6	420 km frontage fenced and revegetated	Improving turbidity water quality attainment towards SEPP Waters of	*Waterway Management and Implementation Plan*

[22] Based on a reduction of 2.5 kg/km/yr total phosphorous due to fencing and revegetation (see Assumptions in Appendix 14).

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
L2.11		Encourage land managers in Reach 23 to adopt CRP for "*Stabilising bed and banks"*.	CMA	Program F	40 km of stream under CRP	Victoria requirements at Gauge 404210	*Water Quality strategy*
High Risk to Assets							
L2.12	Water quality trend (pH)	Conduct an Ecological Risk Assessment in Management Unit L2 for pH, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	30	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*
Medium Risk to Assets							
L2.13	Introduced fauna	Support actions within the Murray Darling Basin Native Fish Management Strategy	CMA	Costed in MDBC Strategy	Control and manage introduced species	Contribute to an overall enhancement of stream health and water quality	*Murray Darling Basin Native Fish Management Strategy*
L2.14	Degraded riparian veg.	Monitor assets at risk from threat - wetlands (and see actions for Stock Access and Water Quality – turbidity)	CMA	Program G	Monitoring program implemented (see Chapter 15)	No decline in condition of assets.	*Monitoring, Evaluation and Reporting Program* to be developed
L2.15	Loss of in-stream habitat	Monitor assets at risk from threat - Murray cod populations	CMA	Program G			
L2.16	Introduced flora	Monitor assets at risk from threat - wetlands (and see actions for Stock Access and Water Quality – turbidity)	CMA	Program G			
L2.17	Bank erosion	Monitor assets at risk from threat - Murray cod populations (and see actions for Water Quality – turbidity)	CMA	Program G			
L2.18	Wetland connectivity	Monitor assets at risk from threat - wetland conditions in Barmah forest and modify environmental flow regime if conditions decline	CMA	Program G			

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit L2

Threat	High Value Assets Protected
Flow deviation	Significant EVC, Native fish community, Significant flora, Flagship species, Fishing, Motor boating.
Stock Access	Significant EVC, Riparian continuity, Native fish community, Significant flora, Camping, Fishing, Flagship species, Water supply delivery.
Water Quality	Significant EVC, Native fish community, Fishing, Flagship species, Water supply delivery.

9.3 Management Unit L4 – Western Catchment (Goulburn Basin Reaches 30-34)

Management Unit L4 – Western Catchment – covers a number of isolated waterways to the west of the Goulburn Basin, with a total length of 152 km. Five reaches make up the management unit, of which one, Gobarup Creek Reach 33 is classified as a High Priority Waterway. Gobarup Creek is a tributary of Wanalta Creek which ultimately terminates in the Wallenjoe Wetlands. Wanalta Creek is not listed as an ISC reach and so has no 1999 ISC data from which to assess threats.

River	ISC Reaches	High Values to be protected
Gobarup Creek	33	Association with wetlands of national significance
Wanalta Creek	n.a.	Association with wetlands of national significance

Only one threat in the reach is at a level that could cause a risk to the high environmental value in Gobarup Creek. Stock access presents a medium risk to the downstream wetland asset and should be addressed (Table 9.3). It is noted that Flow Deviation is believed to be a major threat to the wetlands in this reach (D. Lavery, GBCMA, pers. comm.), but no information on the extent of flow deviation is available. This will need to be addressed in the 2004 review of ISC data.

Table 9.3. Actions and targets in Management Unit L4 – Western Catchments – under the Regional River Health Strategy

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Medium Risk to Assets							
L4.1	Stock access	Provide fencing and revegetation incentives.	CMA	460	50 km frontage fenced	Improve condition of ISC Streamside Zone sub-index by up to 8 points over 13 km river. Improve ISC Physical Form sub-index by up to 1 point over 13 km river.	*Waterway Management and Implementation Plan*
L4.2		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	50 km frontage under CRP		*Water Quality strategy*
L4.3		Control grazing on public waterfronts	DSE (CLM)	Program E	50 km of frontage controlled		*Licensed Grazing (Public Land)*
L4.4	Flow deviation	Investigate the potential impacts of flow deviation on wetland systems.	CMA	5	Flow deviation data reviewed	n.a.	*CMA Research and Investigations*

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit L4

Threat	High Value Assets Protected
Stock access	Significant EVC, Fauna rarity, Native fish community, Flagship species, Water supply delivery

9.4 Management Unit L5 – Lower Broken River (Broken Basin Reaches 1-2)

Management Unit L5 – Lower Broken River – covers the lower Broken River, downstream from Casey's Weir through to the confluence with the Goulburn River. The total length of stream in the Management Unit is 62.5 km. Two reaches have been identified in the Management Unit, both of which are High Priority Reaches.

River	ISC Reaches	High Values to be protected
Broken River	1 - 2	Association with wetlands of national significance; Murray cod; Silver perch (Reach 1).

A number of threats to high value assets have been identified in each reach and actions to address these threats are outlined in Table 9.4. It should be noted that a number of the actions identified for Management Unit L5 are currently being addressed under the Stressed Rivers and Healthy Rivers initiatives. These programs aim to contribute to the resource condition targets as determined.

Threats identified to high value assets in Management Unit L5

Reach	Very High Risk to values	High Risk to values	Medium Risk to values
1 - 2	Flow deviation Barrier to fish migration (Reach 2 only)	Stock access Water quality SIGNAL, Water quality (turbidity, DO, Nutrients)	Bed instability (M2) Channel modification (M2) Loss of instream habitat (M2) Introduced flora (M2) Introduced fauna (M2)

Table 9.4. Actions and targets in Management Unit L5 – Lower Broken River – under the Regional River Health Strategy

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Very High Risk to Assets							
L5.1	Barrier to fish migration	Provide and monitor fish passage at Gowangardie and Casey's Weirs.	CMA	1,500	2 fishways installed	223 km of stream open to fish passage	*Fishway Program*
L5.2	Flow deviation	Develop a Flow Rehabilitation Plan (Broken River).	CMA/GMW/DSE	150	Flow plan developed (establish environmental water reserve & improve flow regime)	As determined by Flow Plan	*Flow Management Plan*
		Implementation of Action 3.9 (Our Water, Our Future to meet commitment to Living Murray project) Initiate supporting initiatives under the "Improving Flow and Habitat in the Broken River" project	DSE CMA				
High Risk to Assets							
L5.3	Stock access	Provide fencing and revegetation incentives.	CMA	1,150	125 km frontage fenced and revegetated	Improve condition of ISC Streamside Zone sub-index by up to 8 points over 63 km river. Improve ISC Physical Form sub-index by up to 1 point over 63 km river.	*Waterway Management and Implementation Plan*
L5.4		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*" .	DSE, CMA	Program F	125 km frontage under CRP		*Water Quality strategy*
L5.5		Control grazing on public waterfronts.	DSE (CLM)	Program E	125 km frontage controlled		*Licensed Grazing (Public Land)*
L5.6	Water quality (turbidity, DO)	Conduct an Ecological Risk Assessment in Management Unit L5 for turbidity and DO, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	30	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*
L5.7	Water quality (Nutrients)	Provide fencing and revegetation incentives	CMA	See L5.3	125 km frontage fenced and revegetated	Reduction in phosphorous exports of 312.5 kg/year[23] at Gauge 404224	*Waterway Management and Implementation Plan*
L5.8		Minimise nutrient run-off into irrigation drains by implementation of on-farm BMP by irrigators as outlined in the Irrigation Drainage Program of the Water Quality Strategy	GMW, DPI	See L1.10, L1.11	Programs implemented as determined.	Contribute to reduction in phosphorous exports of 84.5 tonnes per year from the Shepparton Irrigation District.	*Water Quality Strategy*
L5.9		Remove phosphorous from irrigation drains through water re-use, sediment removal and nutrient stripping, as outlined in the Irrigation Drainage Program of the Water Quality Strategy.	GMW, DPI				
L5.10		Minimise nutrient discharge to rivers by reducing nutrient generation to wastewater facilities, and from wastewater	Urban Water Authorities	0		Contribute to 80% reduction below 1996	

[23] Based on a reduction of 2.5 kg/km/yr total phosphorous due to fencing and revegetation (see Assumptions in Appendix 14).

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
		sources by disposal to land and/or improved treatment.				levels in total phosphorous exports from wastewater facilities.	
L5.11		Implement BMP for urban drainage as outlined in the Urban Stormwater Management Program of the Water Quality Strategy.	Local shires	See L1.13		Contribute to reduction in phosphorous exports of 2.85 tonnes per year from the Shepparton Irrigation District.	
Medium Risk to Assets							
L5.12	Introduced fauna	Support actions within the Murray Darling Basin Native Fish Management Strategy	CMA	Costed in MDBC Strategy	Control and manage introduced species	Contribute to an overall enhancement of stream health and water quality	Murray Darling Basin Native Fish Management Strategy
L5.13	Bed Instability	Monitor assets at risk from threat - Murray cod populations.	CMA	Program G	Monitoring program implemented (see Chapter 15)	No decline in condition of assets.	*Monitoring, Evaluation and Reporting Program* to be developed
L5.14	Channel modification		CMA	Program G			
L5.15	Loss of in-stream habitat		CMA	Program G			
L5.16	Introduced flora	Monitor assets at risk from threat - Murray cod populations and wetland conditions.	CMA	Program G			

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit L5

Threat	High Value Assets Protected
Barrier	
Flow deviation	Significant EVC, Significant flora, Riparian vegetation, Fishing, Flagship species.

9.5 Management Unit M1 – Mid Broken River (Broken Basin Reaches 3 and 4)

Management Unit M1 – Mid Broken River – consists of the Broken River from Katamatite to the downstream wall of Lake Nillahcootie. The total length of stream in the Management Unit is 55 km. Both of the reaches that make up the Management Unit are identified as High Priority Reaches due to the presence of Murray cod and Macquarie perch.

River	ISC Reaches	High Values to be protected
Broken River	3	Macquarie perch, Murray cod
Broken River	4	Macquarie perch, Murray cod

A number of threats to high value assets have been identified in each reach and actions to address these threats are outlined in Table 9.5.

Threats identified to high value assets in Management Unit M1

Reach	Very High Risk to values	High Risk to values	Medium Risk to values
3	Stock access Flow deviation Barrier to fish migration	Channel modification Water quality (turbidity, DO, TN, TP) Water quality SIGNAL Water quality trend (pH, turbidity) Temperature	Introduced flora (M2)
4	Stock access Flow deviation Barrier to fish migration Water quality (turbidity, EC, DO, TN, TP)	Channel modification Water quality trend (pH, turbidity, EC) Temperature	Introduced flora (M2) Degraded riparian vegetation (M2)

Table 9.5. Actions and targets in Management Unit M1 – Mid Broken River – under the Regional River Health Strategy

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Very High Risk to Assets							
M1.1	Stock access	Provide fencing and revegetation incentives.	CMA	1,012	110 km frontage fenced and revegetated	Improve condition of ISC Streamside Zone sub-index by up to 8 points over 22.5 km river. Improve ISC Physical Form sub-index by up to 1 point over 22.5 km river.	*Waterway Management and Implementation Plan*
M1.2		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*" .	DSE, CMA	Program F	110 km frontage under CRP		*Water Quality strategy*
M1.3		Control grazing on public waterfronts.	DSE (CLM)	Program E	110 km frontage controlled		*Licensed Grazing (Public Land)*
M1.4	Flow deviation	Develop a Flow Rehabilitation Plan (Broken River).	CMA	See L5.2	Flow plan developed	As determined by Flow Plan	*Flow Management Plan*
M1.5	Barrier to fish migration	Provide fish passage at Gowangardie and Casey's Weirs.	CMA	See L5.1	2 fishways installed	55 km of stream open	*Fishway Program*

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
						to fish passage	
M1.6	Water quality (Nutrients)	Provide fencing and revegetation incentives	CMA	See M1.1	110 km frontage fenced and revegetated	Reduction in phosphorous exports of 312.5 kg/year[24] at Gauge 404216	*Waterway Management and Implementation Plan*
M1.7	Water quality trend (turbidity, DO, EC)	Conduct an Ecological Risk Assessment in Management Unit M1 for turbidity, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	30	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*
High Risk to Assets							
M1.8	Temperature	Assess impact of Lake Nillahcootie on downstream temperature regimes. If significant, assess potential for modification of release water temperature in conjunction with modifications to the weir wall outlined in the White Paper	CMA	5	Review conducted.	As determined by Review	*CMA Research and Investigations*
M1.9	Channel modification	Assess causes of channel modification (de-snagging or alignment) and prepare appropriate management actions.	CMA	5	Review conducted.	As determined by Review	*Waterway Management and Implementation Plan*
Medium Risk to Assets							
M1.10	Introduced flora	Monitor assets at risk from threat - Murray cod and Macquarie perch populations	CMA	Program G	Monitoring program implemented (see Chapter 15)	No decline in condition of assets.	*Monitoring, Evaluation and Reporting Program* to be developed
M1.11	Degraded riparian vegetation		CMA	Program G			

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit M1

Threat	High Value Assets Protected
Stock access	Significant EVC, Invertebrates, Riparian structural intactness and width, Fishing, Flagship species, Swimming, Water supply delivery.
Flow deviation	Significant EVC, Riparian structural intactness, Fishing, Flagship species, Swimming.
Barrier	Fishing, Flagship species,
Water quality	Invertebrates, Significant EVC, Significant flora, Fishing, Flagship species, Water supply delivery.

[24] Based on a reduction of 2.5 kg/km/yr total phosphorous due to fencing and revegetation (see Assumptions in Appendix 14).

9.6 Management Unit M2 – Upper Broken River (Broken Basin Reaches 5, 6, 11 and 12)

Management Unit M2 – upper Broken River – consists of the Broken River upstream of Lake Nillahcootie and the major upstream tributaries of Halls Weir Creek and Sawpit Creek. The total length of stream in the Management Unit is 52.5 km. Of the four reaches that make up the Management Unit, only Reach 5 immediately upstream of Lake Nillahcootie is recognised as a High Priority Reach, due to the presence of Murray cod and Macquarie perch.

River	ISC Reaches	High Values to be protected
Broken River	5	Macquarie perch, Murray cod

A number of threats to high value assets have been identified in each reach and actions to address these threats are outlined in Table 9.6.

Threats identified to high value assets in Management Unit M2

Reach	Very High Risk to values	High Risk to values	Medium Risk to values
5	Stock access Barrier to fish migration Water quality SIGNAL	Channel modification Introduced flora Degraded riparian vegetation	Loss of in-stream habitat (M2)

Table 9.6. Actions and targets in Management Unit M2 – Upper Broken River – under the Regional River Health Strategy

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Very High Risk to Assets							
M2.1	Stock access	Provide fencing and revegetation incentives.	CMA	138	15 km frontage fenced and revegetated	Improve condition of ISC Streamside Zone sub-index by up to 8 points over 3.7 km river. Improve ISC Physical Form sub-index by up to 1 point over 3.7 km river.	*Waterway Management and Implementation Plan*
M2.2		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*" .	DSE, CMA	Program F	15 km frontage under CRP		*Water Quality strategy*
M2.3		Control grazing on public waterfronts.	DSE (CLM)	Program E	15 km frontage controlled		*Licensed Grazing (Public Land)*
M2.4	Barrier to fish migration	Explore opportunities to provide fish passage at Lake Nillahcootie in conjunction with modifications to the weir wall outlined in the White Paper	CMA	5	Investigation conducted	As determined by investigation	*Statewide Fishway Strategy*
M2.5	Water quality (Nutrients)	Provide fencing and revegetation incentives	CMA	See M2.1	15 km frontage fenced and revegetated	Reduction in phosphorous exports of 30 kg/year[25].	*Waterway Management and Implementation Plan*
High Risk to Assets							

[25] Based on a reduction of 2.5 kg/km/yr total phosphorous due to fencing and revegetation (see Assumptions in Appendix 14).

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
M2.6	Channel modification	Assess causes of channel modification (de-snagging or alignment) and prepare appropriate management actions.	CMA	5	Review conducted.	As determined by Review	*Waterway Management and Implementation Plan*
M2.7	Introduced flora	Control exotic vegetation on streams and revegetate with native species	CMA	124	7.5 km of stream subject to riparian weed control (heavy infestation)	ISC Streamside Zone sub-index improved by up to 7 points over 3.7 km of river.	*Waterway Management and Implementation Plan*
M2.8	Degraded riparian vegetation	Control exotic vegetation, and provide fencing and revegetation initiatives	CMA, DSE	See M2.1,2.8	15 km frontage fenced and revegetated, 7.5 km of stream subject to riparian weed control	Improve condition of ISC Streamside Zone sub-index by up to 8 points over 3.7 km river. Improve ISC Physical Form sub-index by up to 1 point over 3.7 km river.	*Waterway Management and Implementation Plan*
Medium Risk to Assets							
M2.9	Loss of in-stream habitat	Monitor assets at risk from threat - Murray cod and Macquarie perch populations	CMA	Program G	Monitoring program implemented (see Chapter 15)	No decline in condition of assets.	*Monitoring, Evaluation and Reporting Program* to be developed

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit L5

Threat	High Value Assets Protected
Stock access	Invertebrates, Significant EVC, Significant flora, Riparian vegetation continuity, Fishing, Flagship species, Water supply collection and delivery.
Barrier	Fishing, Flagship species.
Water quality	Invertebrates, Wetlands, Fishing, Flagship species, Water supply collection and delivery.

9.7 Management Unit M3 – Ryans and Holland Creeks (Broken Basin Reaches 13-19)

Management Unit M3 – Ryan and Hollands Creeks – comprises the eastern tributaries of the Broken River, including Ryans and Hollands Creek with Sam Creek and Watchbox Creek. The total length of stream in the Management Unit is 127.5 km. Seven reaches have been identified in the Management Unit, of which 2 are recognised as High Priority Reaches..

River	ISC Reaches	High Values to be protected
Holland Creek	13, 14	Macquarie perch
Ryans Creek	17	Ecologically Healthy River

A number of threats to high value assets have been identified in each reach and actions to address these threats are outlined in Table 9.7.

Threats identified to high value assets in Management Unit M3

Reach	Very High Risk to values	High Risk to values	Medium Risk to values
13	Stock access Water quality (turbidity, DO, Nutrients) Water quality trend (pH) Barrier to fish migration	Channel modification	Flow deviation (M2) Introduced flora (M2) Degraded riparian vegetation (M2)
17	No threats currently risk the status of Ryans Creek Reach 17 (see Program B).		

Table 9.7. Actions and targets in Management Unit M3 – Ryans and Holland Creeks – under the Regional River Health Strategy

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Very High Risk to Assets							
M3.1	Stock access	Provide fencing and revegetation incentives.	CMA	184	20 km frontage fenced and revegetated	Improve condition of ISC Streamside Zone sub-index by up to 8 points over 5 km river. Improve ISC Physical Form sub-index by up to 1 point over 5 km river.	*Waterway Management and Implementation Plan*
M3.2		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*" .	DPI	Program F	20 km frontage under CRP		*Water Quality strategy*
M3.3		Control grazing on public waterfronts.	DPI	Program E	20 km frontage controlled		*Licensed Grazing (Public Land)*
M3.4	Water quality (turbidity, DO)	Conduct an Ecological Risk Assessment in Holland Creek for turbidity and DO, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	30	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*
M3.5	Water quality trend (pH)	Conduct an Ecological Risk Assessment in Holland Creek for pH, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	See M3.4	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
M3.6	Water quality (Nutrients)	Provide fencing and revegetation incentives	CMA	See M3.1	20 km frontage fenced and revegetated	Reduction in phosphorous exports of 50 kg/year[26] at Gauge 404207	*Waterway Management and Implementation Plan*
M3.7	Barrier to fish migration	Provide fish passage or remove barrier at Gowangardie and Casey's Weirs.	CMA	See L5.1	2 fishways installed or barriers removed	127.5 km of stream open to fish passage	*Statewide Fishway Strategy*
High Risk to Assets							
M3.8	Channel modification	Assess causes of channel modification (de-snagging or alignment) and prepare appropriate management actions.	CMA	5	Review conducted.	As determined by Review	*Waterway Management and Implementation Plan*
M3.9	Introduced fauna	Support actions within the Murray Darling Basin Native Fish Management Strategy	CMA	Costed in MDBC strategy	Control and manage introduced species.	Contribute to an overall enhancement of stream health and water quality	Murray Darling Basin Native Fish Management Strategy
Medium Risk to Assets							
M3.10	Flow deviation	Monitor assets at risk from threat – Macquarie perch populations in Holland Creek.	CMA	Program G	Monitoring program implemented (see Chapter 15)	No decline in condition of assets.	*Monitoring, Evaluation and Reporting Program* to be developed
M3.11	Degraded riparian vegetation	Monitor assets at risk from threat – Macquarie perch populations in Holland Creek (see also actions for stock access and water quality – nutrients)	CMA	Program G			
M3.12	Introduced flora	Monitor assets at risk from threat – Macquarie perch populations in Holland Creek.	CMA	Program G			

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit M3

Threat	High Value Assets Protected
Stock access	Significant EVC, Riparian structural intactness, Fishing, Flagship species, Passive recreation, Water supply delivery.
Water quality	Fishing, Flagship species, Water supply delivery.
Barrier	Fishing, Flagship species.

[26] Based on a reduction of 2.5 kg/km/yr total phosphorous due to fencing and revegetation (see Assumptions in Appendix 14).

9.8 Management Unit M6 – Upper Broken and Boosey Creeks (Broken Basin Reaches 25-26)

Management Unit M6 – Upper Broken and Boosey Creeks – covers the upper catchment of Broken Creek, taking in all of the Boosey Creek subcatchment, and the upper reach in Nine Mile Creek. The total length of stream in the Management Unit is 200 km. Eight reaches have been identified in the Management Unit, of which 2 in the Broken Creek have been identified as High Priority Reaches.

River	ISC Reaches	High Values to be protected
Broken Creek	25, 26	Association with wetlands of national significance. Broken-Boosey State Park - unique linear corridor, substantial occurrence of high quality native vegetation

A number of threats to high value assets have been identified in each reach. Actions to address these threats are outlined in Table 9.8. Addressing the priority threats in Management Unit M6 will have additional benefits apart from protecting the notable high value assets

Threats identified to high value assets in Management Unit M6

Reach	Very High Risk to values	High Risk to values	Medium Risk to values
25		Flow deviation Water quality (turbidity, DO, nutrients), Water quality SIGNAL, Water quality trend (pH, turbidity)	Stock access (M1) Introduced flora (M2) Introduced fauna (M2)
26		Flow deviation Water quality SIGNAL	Stock access (M1) Introduced flora (M2) Introduced fauna (M2)

Table 9.8. Actions and targets in Management Unit M6 – Upper Broken and Boosey Creeks – under the Regional River Health Strategy

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
High Risk to Assets							
M6.1	Flow deviation	Undertake risk analyses of values, threats and mitigation measures, and implement negotiated environmental flow regimes.	CMA	See L2.1	Establish environmental water reserve and improve flow regime.	Improved environmental flow regimes for 2 high value river reaches currently flow stressed.	*Flow Management Plan, Fisheries Strategy, Aquatic and native riparian Flora and Fauna program*
M6.2	Water quality (nutrients, turbidity)	Provide fencing and revegetation incentives	CMA	828	90 km frontage fenced and revegetated	Reduction in phosphorous exports of 225 kg/year[27] at Gauge 404214	*Waterway Management and Implementation Plan*

[27] Based on a reduction of 2.5 kg/km/yr total phosphorous due to fencing and revegetation (see Assumptions in Appendix 14).

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
M6.3	Water quality (DO)	Conduct an Ecological Risk Assessment DO, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	30	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*
M6.4	Water quality trend (pH)	Conduct an Ecological Risk Assessment for pH, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	See M6.4	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*
Medium Risk to Assets							
M6.5	Stock access	Provide fencing and revegetation incentives	CMA	See M6.2	90 km frontage fenced	Improve ISC Streamside Zone sub-index by up to 8 points over 22.5 km river. Improve ISC Physical Form sub-index by up to 1 point over 22.5 km river.	*Waterway Management and Implementation Plan*
M6.6		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	90 km frontage under CRP		*Water Quality strategy*
M6.7		Control grazing on public waterfronts	DSE (CLM)	Program E	90 km frontage controlled		*Licensed Grazing (Public Land)*
M6.8	Introduced fauna	Support actions within the Murray Darling Basin Native Fish Management Strategy	CMA	Costed in MDBC strategy	Control and manage introduced species	Contribute to an overall enhancement of stream health and water quality	*Murray Darling Basin Native Fish Management Strategy*
M6.9	Introduced flora	Monitor assets at risk from threat - wetlands (and see actions for Stock access, Water quality and Flow deviation)	CMA	Program G	Monitoring program implemented (see Chapter 15)	No decline in condition of assets.	*Monitoring, Evaluation and Reporting Program* to be developed

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit M6

Threat	High Value Assets Protected
Flow deviation	Significant EVC, Significant flora, Fishing, Flagship species,
Water quality	Invertebrate community, Significant EVC, Flagship species, Water supply delivery.

9.9 Management Unit M7 – Euroa Strathbogie (Goulburn Basin Reaches 19, 20, 26 and 28)

Management Unit M7 – Euroa Strathbogie– covers the upper sections of eastern tributaries that flow into the Goulburn River downstream of Goulburn Weir, a total length of stream of 100 km. Four reaches form the Management Unit, of which two (Seven Creeks Reaches 19 and 20) are classified as High Priority Waterways.

River	ISC Reaches	High Values to be protected
Seven Creeks	19	Trout cod Macquarie perch Site of Significance (geological)
Seven Creeks	20	Macquarie perch

Seven Creeks Reach 19 is classified as a Site of Significance due to the geological feature at Goorham Falls. None of the threats in the reach are deemed to pose a potential risk to these features, so all risks were to the Trout cod population in Reach 19 and Macquarie perch in both reaches.

Threats identified to high value assets in Management Unit M7

Reach	Very High Risk to values	High Risk to values	Medium Risk to values
19	Stock access Water quality SIGNAL Water quality (Nutrients, DO)		Bed instability (M2) Loss of in-stream habitat (M2) Introduced flora (M2) Introduced fauna (M2)
20	Stock access Water quality SIGNAL Water qualityl (Nutrients, turbidity)	Water quality trend (pH, turbidity)	Channel modification (M2) Introduced fauna (M2) Barriers to fish migration (M2) Degraded riparian vegetation (M2)

While the Medium Risk threats are all rated M2 (suggesting that monitoring would be an appropriate management response), due to the importance of the Trout cod populations in Reach 19 as a National asset, these threats will be addressed within this plan (Table 9.9), including in the upstream reach. Protecting and enhancing the Trout cod and Macquarie perch population will have benefits for other high value assets in the reach.

Table 9.9. Actions and targets in Management Unit M7 – Euroa Strathbogie – under the Regional River Health Strategy

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Very High Risk to Assets							
M7.1	Stock access	Provide fencing and revegetation incentives	CMA	700	76 km frontage fenced	Improve ISC Streamside Zone sub-index by up to 8 points over 19 km river. Improve ISC Physical Form sub-index by up to 1 point over 19 km river.	*Waterway Management and Implementation Plan*
M7.2		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	76 km frontage under CRP		*Water Quality strategy*
M7.3		Control grazing on public waterfronts	DSE (CLM)	Program E	76 km frontage controlled		*Licensed Grazing (Public Land)*
M7.4	Water quality (nutrients)	Provide fencing and revegetation incentives	CMA	See M7.1	76 km frontage fenced and revegetated	Reduction in phosphorous exports of 190 kg/year[28] at Gauge 405237	*Waterway Management and Implementation Plan*
High Risk to Assets							
M7.5	Water quality trend (DO, pH)	Conduct an Ecological Risk Assessment for DO and pH, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	30	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*
Medium Risk to Assets							
M7.6	Bed Instability	Stabilise in-stream erosion	CMA	92	20.5 km of river with instream erosion improvement works	Improve ISC Physical Form sub-index by 1 point over 11 km of river.	*Waterway Management and Implementation Plan*
M7.7	Loss of in-stream habitat	Enhance Aquatic Refugia to protect instream habitat (protection zones)	CMA	410	20.5 km of river with habitat improvement works		*Waterway Management and Implementation Plan*
M7.8	Introduced flora	Control exotic vegetation on streams	CMA	21	20.5 km of stream subject to riparian weed control	Improve ISC Streamside Zone sub-index by up to 7 points over 11 km river.	*Waterway Management and Implementation Plan* *Willow Management Plan*

[28] Based on a reduction of 2.5 kg/km/yr total phosphorous due to fencing and revegetation (see Assumptions in Appendix 14).

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
M7.9	Introduced fauna	Rabbits controlled	CMA	Funded under Rabbit Plan	38 km of stream subject to rabbit control	Rabbit population significantly reduced over 38 km of stream	*Rabbit Action Plan*
M7.10		Monitor assets at risk from threats – Trout cod and Macquarie perch populations	CMA	Program G	Monitoring program implemented (see Chapter 15)	No decline in condition of assets.	*Monitoring, Evaluation and Reporting Program* to be developed

Additional actions in Management Unit M7.

Other actions already underway in Management Unit M7 will assist in achieving the protection of important assets in the High Priority Reaches.

Actions	Management Action Target	Resource Condition Target	Sub-Programs
Complete Seven Creeks Stream Flow Management Plan. Implement the key recommendations contained within the plan, integrating any supplementary catchment management works with recommended actions in this Strategy.	Seven Creeks Streamflow Management Plant completed and negotiated environmental flow regime implemented.	Improved environmental flow regimes for 2 high value river reaches.	*Flow Management Plan, Fisheries Strategy, Aquatic and native riparian Flora and Fauna program*

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit M7

Threat	Other High Value Assets Protected
Stock access	Invertebrate community, Significant EVC, Native fish community, Flagship species, Passive recreation, Swimming, Water supply delivery
Water quality	Invertebrate community, Significant EVC, Native fish community, Flagship species, Swimming, Water supply delivery

9.10 Management Unit U1 – Mid Goulburn River (Goulburn Basin Reaches 9-14)

Management Unit U1 – Mid Goulburn River – covers the length of the Goulburn River between Eildon Reservoir and Goulburn Weir, a total length of stream of 145 km. Six reaches form the Management Unit. All six reaches are classified as High Priority Reaches.

River	ISC Reaches	High Values to be protected
Goulburn River	9-14	Heritage River

Heritage River values in Management Unit U1 are based on a number of different values: significant habitat for vulnerable or threatened terrestrial wildlife, Macquarie Perch habitat, fishing opportunities for trout, canoeing opportunities, European cultural sites, and scenic landscapes from Molesworth to Seymour.

A large number of threats to these notable assets in Management Unit U1 have been identified, the majority representing a very High risk to one or more valuable assets. Individual reach risk assessment results are found in Appendix 10. A number of the threats in the Management Unit (particularly flow deviation and water temperature) are of a nature that addressing other threats would not produce the desired improvement in environmental condition. In addition, a number of the values in the Management Unit are conflicting (e.g. fishing opportunities for trout, and Macquarie perch habitat), so that protecting one value may result in a decline in another value.

Threats identified to high value assets in Management Unit U1

Reach	Very High Risk to values	High Risk to values	Medium Risk to values
9-14	Bank erosion Bed instability Loss of instream habitat Stock access Flow deviation Water quality SIGNAL Temperature Algal Blooms Introduced flora Barrier to fish migration Degraded riparian vegetation	Water quality trend (ph, Turbidity)	Channel modification (M2)

The Goulburn Broken CMA, in conjunction with other stakeholders, will work towards the resolution of prioritising the primary values (for both land and water) to be protected or enhanced. The first step will be to develop clear achievable environmental objectives for the Management Unit, which will provide direction for resolution of major widespread issues, particularly the migration of native fish upstream of Goulburn Weir, changes to the flow regime and reduced water temperatures.

Table 9.10 Actions in Management Unit U1 – Mid Goulburn River – under the Regional River Health Strategy

No.	Objective	Action / Activity	Indicative Cost
U1.1	Establishment of clear management objectives for the Goulburn River	Conduct deliberative forum with CMA, major stakeholders and community representatives to establish clear achievable environmental objectives for the Management Unit, which will provide direction for resolution of major widespread issues, particularly the migration of native fish upstream of Goulburn Weir, changes to the flow regime and reduced water temperatures.	$25,000

Over the short-term, other actions in this Management Unit will be primarily a reactive program (focussed on the fundamental physical, chemical and biological threats to river health) to specific and critical issues or threats as they arise, which will be guided by the following table.

Additional actions in Management Unit U1.

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Very High Risk to Assets							
U1.2	Bank Erosion and Bed Instability	Stabilise near stream erosion	CMA	Not costed	Localised bank erosion controlled on reactive basis	Improve ISC Physical Form sub-index by 1 point over 50 km of river (Reaches 9-14).	*Waterway Management and Implementation Plan*
U1.3		Encourage land managers to adopt CRP for "*Stabilising bed and banks*".	CMA, DSE	Program F			
U1.4	Loss of in-stream habitat	Enhance Aquatic Refugia to protect instream habitat (protection zones)	CMA	100	50 km of river with habitat improvement works	Improve ISC Physical Form sub-index by 1 point over 25 km of river (Reaches 9-14).	*Waterway Management and Implementation Plan*
U1.5	Flow Deviation	Complete Goulburn environmental flow project, undertake economic assessment of improved river health, and implement recommendations with negotiated environmental water reserve and improved flow regimes by 2010.	DSE	See L1.1	Goulburn environmental flow project completed and negotiated environmental flow regime implemented.	Establish environmental water reserve and improved flow regimes for 6 high value river reaches currently flow stressed.	*Flow Management Plan, Fisheries Strategy, Aquatic and native riparian Flora and Fauna program*
U1.6		Review Bulk Entitlement for Goulburn River as part of Victoria's contribution to the Living Murray process	DSE, CMA	See L1.2	Bulk Entitlement reviewed		*Flow Management Plan*
U1.7		Review the operating procedures of Goulburn Weir with a view to optimising water levels for the protection of the aquatic ecosystem.	GMW, DSE, CMA	See L1.3	Operations reviewed		*Fisheries Strategy*
U1.8	Stock access	Provide fencing and revegetation incentives	CMA	1,840	200 km frontage fenced and revegetated	Improve ISC Streamside Zone sub-index by up to 8 points over 50 km river.	*Waterway Management and Implementation Plan*
U1.9		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	200 km frontage under CRP	Improve ISC Physical Form sub-index by up to 1 point over 50 km river.	*Water Quality strategy*
U1.10		Control grazing on public waterfronts	DSE (CLM)	Program E	200 km frontage controlled		*Licensed Grazing (Public Land)*

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
U1.11	Water quality (nutrients, turbidity)	Refine Sednet Model for water quality benefits (program targets)	CMA	80	Model refined to Best Available Data	n.a.	*CMA Research and Investigations*
		Stabilise near stream erosion	CMA	Not costed	Localised bank erosion controlled on reactive basis	Reduction in fine and coarse sediment mobilisation of 60 t/km/yr	
U1.12		Provide fencing and revegetation incentives	CMA	See U1.8	200 km frontage fenced and revegetated	Reduction in phosphorous exports of 190 kg/year[29]. Reduction in occurrence of algal blooms	*Waterway Management and Implementation Plan, Water Quality Strategy*
U1.14		Minimise nutrient discharge to rivers by reducing nutrient generation to wastewater facilities, and from wastewater sources by disposal to land and/or improved treatment.	Urban Water Authorities	0	Programs implemented as determined	Contribute to 80% reduction below 1996 levels in total phosphorous exports from wastewater facilities.	
U1.15		Implement BMP for urban drainage as outlined in the Urban Stormwater Management Program of the Water Quality Strategy.	Local shires	4,350[30]	Programs implemented as determined	Contribute to reduction in phosphorous exports of 3.05 tonnes per year from the Mid Goulburn Region.	
U1.16	Water quality trend (pH)	Conduct an Ecological Risk Assessment for pH, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	30	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*
U1.17	Introduced flora	Control exotic vegetation on streams	CMA	825	50 km of stream subject to riparian weed control	Improve ISC Streamside Zone sub-index by up to 7 points over 25 km river.	*Waterway Management and Implementation Plan Willow Management Plan*
U1.18	Barriers to fish migration	Investigate options for Fish Barrier modifications at Goulburn Weir	CMA	50	Investigation completed	As determined by investigation	*CMA Research and Investigations*

[29] Based on a reduction of 2.5 kg/km/yr total phosphorous due to fencing and revegetation (see Assumptions in Appendix 14).
[30] Includes actions in tributaries to Management Unit U1.

9.11 Management Unit U2 – Majors Creek and Hughes Creek (Goulburn Basin Reaches 35-40)

Management Unit U2 – Majors Creek and Hughes Creek – covers the lower eastern and western tributaries of the Goulburn River between Eildon Reservoir and Goulburn Weir (Majors, Bylands, Hughes and Whitehead Creeks), a total length of stream of 132.5 km. Six reaches form the Management Unit, of which one is classified as High Priority Reaches.

River	ISC Reaches	High Values to be protected
Hughes Creek	37	Murray cod; Macquarie perch.

Few threats to high value assets have been identified in each reach and actions to address these threats are outlined in Table 9.11.

Threats identified to high value assets in Management Unit U2

Reach	Very High Risk to values	High Risk to values	Medium Risk to values
37	Stock access Barrier to fish migration		Introduced flora (M2) Loss of in-stream habitat (M2)

Table 9.11. Actions and targets in Management Unit U2 – Majors Creek and Hughes Creek – under the Regional River Health Strategy

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Very High Risk to Assets							
U2.1	Stock access	Provide fencing and revegetation incentives	CMA	368	40 km frontage fenced	Improve ISC Streamside Zone sub-index by up to 8 points over 10 km river. Improve ISC Physical Form sub-index by up to 1 point over 10 km river.	*Waterway Management and Implementation Plan*
U2.2		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	40 km frontage under CRP		*Water Quality strategy*
U2.3		Control grazing on public waterfronts	DSE (CLM)	Program E	40 km frontage controlled		*Licensed Grazing (Public Land)*
Medium Risk to Assets							
U2.4	Introduced flora	Monitor assets at risk from threat – Murray cod and Macquarie perch populations	CMA	Program G	Monitoring program implemented (see Chapter 15)	No decline in condition of assets.	*Monitoring, Evaluation and Reporting Program*
U2.5	Loss of in-stream habitat						

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit U2

Threat	Other High Value Assets Protected
Stock access	Significant EVC, Riparian structural intactness, Flagship species, Water supply delivery

9.12 Management Unit U4 – King Parrot Creek/Yea River (Goulburn Basin Reaches 51-59)

Management Unit U4 – King Parrot Creek/Yea River – covers a number of north flowing tributaries that flow into the Goulburn River downstream of Eildon Reservoir, a total length of stream of 167.5 km. Nine reaches make up the Management Unit, of which two are classified as High Priority Reaches (both for the presence of Macquarie perch).

River	ISC Reaches	High Values to be protected
King Parrot Creek	51	Macquarie perch
Yea River	55	Macquarie perch.

A number of threats to high value assets have been identified in each reach and actions to address these threats are outlined in Table 9.12.

Threats identified to high value assets in Management Unit U4

Reach	Very High Risk to values	High Risk to values	Medium Risk to values
51	Stock access Water quality SIGNAL	Barrier to fish migration	Bank erosion (M2) Flow Deviation (M2) Introduced flora (M2)
55	Stock access	Barrier to fish migration	

Table 9.12. Actions and targets in Management Unit U4 – King Parrot Creek/Yea River – under the Regional River Health Strategy

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Very High Risk to Assets							
U4.1	Stock access	Provide fencing and revegetation incentives	CMA	920	100 km frontage fenced	Improve ISC Streamside Zone sub-index by up to 8 points over 25 km river. Improve ISC Physical Form sub-index by up to 1 point over 25 km river.	*Waterway Management and Implementation Plan*
U4.2		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	100 km frontage under CRP		*Water Quality strategy*
U4.3		Control grazing on public waterfronts	DSE (CLM)	Program E	100 km frontage controlled		*Licensed Grazing (Public Land)*
U4.4	Water quality SIGNAL	Provide fencing and revegetation incentives	CMA	See U2.1	100 km frontage fenced	Reduction in phosphorous exports of 250 kg/year[31] at Gauge 405231	*Waterway Management and Implementation Plan*
Medium Risk to Assets							

[31] Based on a reduction of 2.5 kg/km/yr total phosphorous due to fencing and revegetation (see Assumptions in Appendix 13).

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
U4.5	Flow deviation	Finalise the King Parrot Creek Streamflow Management Plan, implement negotiated environmental water reserve and undertake complementary river health activities.	DSE, CMA	150*	Streamflow Management Plan completed and negotiated environmental flow regime implemented.	Establish environmental water reserve and improved flow regimes for 1 high value river reach.	*Flow Management Plan, Fisheries Strategy, Aquatic and native riparian Flora and Fauna program*
U4.6		Monitor assets at risk from threat – Macquarie perch populations	CMA	Program G	Monitoring program implemented (see Chapter 15)	No decline in condition of assets.	*Monitoring, Evaluation and Reporting Program* to be developed
U4.7	Introduced flora	Monitor assets at risk from threat – Macquarie perch populations					
U4.8	Bank erosion						

* - already funded

Additional actions in Management Unit U4.

Other actions already underway in Management Unit U4 will assist in achieving the protection of important assets in the High Priority Reaches.

Actions	Management Action Target	Resource Condition Target	Sub-Programs
Complete Yea River Creeks Stream Flow Management Plan. Implement the key recommendations contained within the plan, integrating any supplementary catchment management works with recommended actions in this Strategy.	Yea River Streamflow Management Plant completed and negotiated environmental flow regime implemented.	Establish environmental water reserve and improved flow regimes for 1 high value river reach, and 5 non-priority reaches.	*Flow Management Plan, Fisheries Strategy, Aquatic and native riparian Flora and Fauna program*
Integrate any supplementary catchment management works in the King Parrot Streamflow Management Plan with recommended actions in this Strategy.	Agreed catchment management works in the King Parrot Streamflow Management Plan implemented.	As determined by agreed actions, according to targets in Table 9.12	*Flow Management Plan, Fisheries Strategy, Aquatic and native riparian Flora and Fauna program*

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit U4

Threat	Other High Value Assets Protected
Stock access	Invertebrates, Significant EVC, Riparian width, continuity and intactness, Fishing, Flagship species, Passive recreation, Water supply delivery
Water quality	Invertebrates, wetlands, Fishing, Flagship species, Water supply delivery.

9.13 Management Unit U6 – Acheron, Rubicon and Taggerty Rivers (Goulburn Basin Reaches 62-66)

Management Unit U6 – Acheron, Rubicon and Taggerty Rivers – covers a number of north flowing tributaries that flow into the Goulburn River downstream of Eildon Reservoir, a total length of stream of 100 km. Five reaches form the Management Unit, of which 3 are classified as High Priority Reaches.

River	ISC Reaches	High Values to be protected
Acheron River	62	Site of Significance
Taggerty River	64	Ecologically Healthy River; Representative River; Barred galaxias
Rubicon River	66	Barred galaxias

The Acheron River Reach 62 is classified as a Site of Significance due to the history of freshwater scientific research conducted in the river (therefore related to its value as a natural river) so the risk-based analysis was conducted as for an ecologically healthy river.

Two significant threats have been identified in the Acheron River reach. No significant threats have been identified in the Taggerty River (see Program B), so all actions are for the Acheron River reach (Table 9.13). Because the threats are to the value of a Site of Significance, based on the value of a natural river environment, addressing the threats will have benefits to all environmental assets in the reach.

The identification of flow deviation as a very high risk to the Barred galaxias is an artefact of the risk-based assessment. The source of the flow deviation (the Rubicon and Royston Rivers hydro power stations) are located well below the habitats of the barred galaxias, and thus do not present a threat to the species.

Threats identified to high value assets in Management Unit U6

Reach	Very High Risk to values	High Risk to values	Medium Risk to values
62	Loss of in-stream habitat	Stock access	Introduced fauna (M2)
64	No Very High, High or Medium threats currently risk the status of Taggerty River Reach 64 (see Program B).		
66	Flow deviation		

Table 9.13. Actions and targets in Management Unit U6 – Acheron, Rubicon and Taggerty River – under the Regional River Health Strategy

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Very High Risk to Assets							
U6.1	Loss of in-stream habitat	Enhance Aquatic Refugia to protect instream habitat (protection zones)	CMA	500	25 km of river with habitat improvement works	Improve ISC Physical Form sub-index by 1-2 points over 12.5 km or river in Reach 64	*Waterway Management and Implementation Plan*

High Risk to Assets							
U6.2	Stock access	Provide fencing and revegetation incentives	CMA	460	50 km frontage fenced and revegetated	Improve ISC Streamside Zone sub-index by up to 8 points over 12.5 km river.	*Waterway Management and Implementation Plan*
U6.3		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	50 km frontage under CRP	Improve ISC Physical Form sub-index by up to 1 point over 12.5 km river.	*Water Quality strategy*
U6.4		Control grazing on public waterfronts	DSE (CLM)	Program E	50 km frontage controlled		*Licensed Grazing (Public Land)*
Medium Risk to Assets							
U6.5	Introduced fauna	Monitor assets at risk from threat – riparian condition	CMA	Program G	Monitoring program implemented (see Chapter 15)	No decline in condition of assets.	*Monitoring, Evaluation and Reporting Program* to be developed

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit U6

Threat	Other High Value Assets Protected
Loss of in-stream habitat	Significant fauna, Fishing, Flagship species.

9.14 Management Unit U7 – Upper Goulburn Catchment (Goulburn Basin Reaches 15-16, 67-72)

Management Unit U7 – upper Goulburn Catchment – covers the Goulburn River and major tributaries upstream of Eildon Reservoir, a total length of stream of 200 km. Eight reaches have been identified in the Management Unit, all of which are High Value Reaches.

River	ISC Reaches	High Values to be protected
Goulburn River	15	Ecologically healthy river, Macquarie perch.
Goulburn River	16	Barred galaxias; Spotted tree frog, Alpine bent.
Big River	67	Heritage River Ecologically Healthy River, Spotted tree frog.
Big River	68	Heritage River, Ecologically Healthy River, Representative River.
Howqua River	69	Heritage River, High economic value.
Howqua River	70	Heritage River
Delatite River	71	Murray cod
Delatite River	72	High overall economic significance

Few threats form Very High or High risks to significant values in other reaches in Management Unit U7. The major threats in the reaches are in the Delatite River (Reach 71). The barrier to fish migration identified is Eildon Weir, which is unlikely to ever be fitted with a fishway (so no actions are proposed). In other reaches, poor quality streamside zone, introduced flora and Water quality are the main threats. Actions to address these threats are outlined in Table 9.14.

Threats identified to high value assets in Management Unit U7

Reach	Very High Risk to values	High Risk to values	Medium Risk to values
15		Water quality Trend (pH, EC)	Introduced flora (M2)
16	Introduced flora	Degraded riparian vegetation	
67	No threats currently risk the status of Big River Reach 67 (see Program B).		
68		Water quality Trend (pH, turbidity and EC)	
69	No threats currently risk the status of Howqua River Reach 69.		
70	No threats currently risk the status of Howqua River Reach 70.		
71	Stock access Barrier to fish migration	Bed instability Water quality Trend (pH, turbidity and EC) Introduced flora Degraded riparian vegetation	Bank erosion (M2) Water quality SIGNAL (M2)
72			Bed instability (M1)

Table 9.14. Actions and targets in Management Unit U7 – Upper Goulburn Catchment – under the Regional River Health Strategy

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Very High Risk to Assets							
U7.1	Stock access	Provide fencing and revegetation incentives	CMA	690	75 km frontage fenced (Reach 71)	Improve ISC Streamside Zone sub-index by up to 8 points over 19 km river.	*Waterway Management and Implementation Plan*
U7.2		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	75 km frontage under CRP (Reach 71)	Improve ISC Physical Form sub-index by up to 1 point over 19 km river.	*Water Quality strategy*
U7.3		Control grazing on public waterfronts	DSE (CLM)	Program E	75 km frontage controlled (Reach 71)		*Licensed Grazing (Public Land)*
U7.4	Introduced flora	Control exotic vegetation on streams and revegetate with native species	CMA	Up to 1,518	Up to 92.5 km of stream subject to riparian weed control (Reaches 15, 16 and 71)	Improve ISC Streamside Zone sub-index by up to 7 points over 46 km river.	*Waterway Management and Implementation Plan*
High Risk to Assets							
U7.5	Water quality trend (pH, EC)	Conduct an Ecological Risk Assessment for pH and EC in the Goulburn River Reach 15, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	30	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*
U7.6	Water quality trend (pH, turbidity and EC)	Conduct an Ecological Risk Assessment for pH, turbidity and EC in the Big River Reach 68, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	30	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*
U7.7	Water quality trend (pH, turbidity and EC)	Conduct an Ecological Risk Assessment for pH, turbidity and EC in the Delatite River Reach 71, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required.	CMA, EPA	30	Ecological Risk Assessment conducted	As determined by Risk Assessment	*Water Quality Strategy*
U7.8	Bed instability	Identify and Stabilise in-stream erosion in the Delatite River (Reaches 71 and 72)	CMA	214	47.5 km of river with instream erosion improvement works	Improve ISC Physical Form sub-index by 1 point over 24 km of river.	*Waterway Management and Implementation Plan*
Medium Risk to Assets							
U7.9	Bank erosion	Monitor assets at risk from threat – Murray cod in the Delatite River	CMA	Program G	Monitoring program implemented (see Chapter 15)	No decline in condition of assets.	*Monitoring, Evaluation and Reporting Program*

Addressing the priority threats in this Management Unit will have additional benefits apart from protecting the notable high value assets.

Other high value assets that would be protected by the actions in Management Unit U7

Threat	Other High Value Assets Protected
Introduced flora	Invertebrates, Significant EVC, Flagship species,
Stock access	Invertebrates, Significant EVC, Fishing, Flagship species, Passive recreation, Water supply collection and delivery

10. Program B: Protection of Ecologically Healthy Rivers

Five reaches in the Goulburn Broken catchment have been identified as Ecologically Healthy Rivers. The only identified threats to the ecologically healthy status of these streams is a declining water quality in the Goulburn River Reach 15 and the Big River Reach 68 (Table 10.1). The source of the declining water quality in these reaches is currently unknown. The cause will be investigated and actions will be developed to reduce or remove these threats under Program A. Otherwise, actions in the five reaches are to monitor (Table 10.2) the condition of the rivers, undertake actions to prevent the impacts on low risk threats (Table 10.3) and respond to any decline in quality (under Program G), prevent any potential decline from inappropriate development (under Program E) and promote public knowledge of the rivers (under Program F). The costs of this program are included under those programs.

Table 10.1 Identified threats in Ecologically Healthy Rivers in the Goulburn Broken catchment.

ISC Reaches	Threats to Ecologically Healthy status
Taggerty River (Goulburn Basin Reach 64)	None
Goulburn River (Goulburn Basin Reach 15)	Water quality Trend (pH, EC) – see Program A
Big River (Goulburn Basin Reach 67)	None
Big River (Goulburn Basin Reach 68)	Water quality Trend (pH, EC) – see Program A
Ryans Creek (Broken Basin Reach 17)	None

Table 10.2 Actions and targets for Ecologically Healthy Rivers under the Regional River Health Strategy.

No.	River	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target
B1	Taggerty River (64)	1. Monitor criteria for ecologically healthy status and respond accordingly to any decline in condition; 2. Monitor development proposals for potential impact on ecologically healthy status and prevent any actions that could potentially cause a decline in conditions; 3. Promote public knowledge of ecologically healthy rivers.	CMA	1. Program G 2. Program E 3. Program F	Status monitored over 17.5 km of river and any decline reversed or prevented.	17.5 km of ecologically healthy river maintained.
B2	Goulburn River (15)				Status monitored over 25 km of river and any decline reversed or prevented.	25 km of ecologically healthy river maintained.
B3	Big River (67)				Status monitored over 27.5 km of river and any decline reversed or prevented.	27.5 km of ecologically healthy river maintained.
B4	Big River (68)				Status monitored over 20 km of river and any decline reversed or prevented.	20 km of ecologically healthy river maintained.
B5	Ryans Creek (17)				Status monitored over 22.5 km of river and any decline reversed or prevented.	22.5 km of ecologically healthy river maintained.

Table 10.3(a) On-ground Actions and targets for Ecologically Healthy Rivers under the Regional River Health Strategy.

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Taggerty River (64)	Stock access	Provide fencing and revegetation incentives	CMA	$20	2 km frontage fenced	17.5 km of ecologically healthy river maintained	*Waterway Management and Implementation Plan*
		Encourage land managers to adopt CRP for "Managing grazing in the riparian zone"	CMA		2 km frontage under CRP		*Water Quality strategy*
		Control grazing on public waterfronts	CMA		2 km frontage controlled		*Licensed Grazing (Public Land)*
	Introduced flora	Control exotic vegetation on streams and revegetate with native species	CMA/CLM	$60	10 km of stream subject to riparian weed control		*Waterway Management and Implementation Plan*
		Manage exotic vegetation on neighbouring lands	CMA/DSE/ Landowners	$60	Weeds managed on 100ha of private land		*Regional Weed Strategy*
	Water Quality (turbidity / sediments)	Minimise sediment discharge to rivers by reducing generation from road networks. Improve management of drainage outfalls.	Parks	$100	Program Implemented as determined.		*Water Quality strategy*
Goulburn River (15)	Stock access	Provide fencing and revegetation incentives	CMA	$15	3 km frontage fenced	15 km of ecologically healthy river maintained	*Waterway Management and Implementation Plan*
		Encourage land managers to adopt CRP for "Managing grazing in the riparian zone"	DSE, CMA		3 km frontage under CRP		*Water Quality strategy*
		Control grazing on public waterfronts	DSE (CLM)		3 km frontage controlled		*Licensed Grazing (Public Land)*
	Introduced flora	Control exotic vegetation (willows, blackberry, broom) on streams and revegetate with native species	CMA / CLM	$200	10 km of stream (20km of frontages) subject to riparian weed control		*Waterway Management and Implementation Plan*
	Water Quality (turbidity / sediments)	Minimise sediment discharge to rivers by reducing generation from road networks.	Local Government	$100	Program Implemented as determined		*Water Quality strategy*
Big River (67)	Introduced flora	Control exotic vegetation (willows, blackberry, broom) on streams and revegetate with native species	CMA/CLM	$100	Up to 10 km of stream subject to riparian weed control.	27.5 km of ecologically healthy river maintained	*Waterway Management and Implementation Plan*
	Water Quality (turbidity / sediments)	Minimise sediment discharge to rivers by reducing generation from road networks	Local Government	$50	Program Implemented as determined		*Water Quality strategy*
	Water Quality / Recreation	Manage Recreational Impacts	CLM / Parks	$50	Program Implemented as determined		*Recreation*

Table 10.3(b) On-ground Actions and targets for Ecologically Healthy Rivers under the Regional River Health Strategy.

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Program
Big River (68)	Introduced flora	Control exotic vegetation (willows, blackberry, broom) on streams and revegetate with native species	CMA/CLM	$50	10 km of stream subject to riparian weed control.	20 km of ecologically healthy river maintained	*Waterway Management and Implementation Plan*
	Water Quality (turbidity / sediments)	Minimise sediment discharge to rivers by reducing generation from road networks	Local Government	$50	Program Implemented as determined		*Water Quality strategy*
Ryans Creek (17)	Introduced flora	Control exotic vegetation (willows, blackberry, broom) on streams and revegetate with native species	CMA/CLM	$50	Up to 10 km of stream subject to riparian weed control.	22.5 km of ecologically healthy river maintained.	*Waterway Management and Implementation Plan*
	Water Quality (turbidity / sediments)	Minimise sediment discharge to rivers by reducing generation from road networks / Minimise impacts from forestry activity (CRP's)	Local Government	$45	Program Implemented as determined		*Water Quality strategy*
	Water Quality / Recreation	Manage Recreational Impacts (Develop Strategy and action)	CLM / Parks	$45	Program Implemented as determined		*Water Quality / Recreation*

11. Program C: Creating More Ecologically Healthy Rivers

Thirteen reaches came close to priority status for ecologically healthy rivers, nearly achieving the criteria, or that could achieve the criteria with a single program (such as riparian restoration). Three of the reaches are listed as High Priority Reaches under some other criterion.

11.1 Goulburn River Reach 16

The upper Goulburn River misses ecologically healthy river status due to the poor quality of the riparian vegetation. This seems unusual, given the nature of the upper catchment, and may reflect only the condition of the sites chosen for ISC assessment. The reach is also classified as a High Priority Reach, and actions proposed under Program A will improve it to ecologically healthy status (Table 9.14).

11.2 Bylands Creek Reach 36

Bylands Creek is a small tributary (25 km) of Majors Creek in Management Unit U2. Data indicate that the in-stream habitat condition is poor.

Actions in Bylands Creek Reach 36 to improve it to ecologically healthy river status.

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Programs
C1	Loss of in-stream habitat	Enhance Aquatic Refugia to improve instream habitat (improvement zones)	CMA	500	25 km of river with habitat improvement works	25 km of river identified as an ecologically healthy river.	*Waterway Management and Implementation Plan*

11.3 Dry Creek Reach 48

Dry Creek is a small tributary (20 km) of Sunday Creek in Management Unit U3. Data indicate that the in-stream habitat condition is poor.

Actions in Dry Creek Reach 48 to improve it to ecologically healthy river status.

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Programs
C2	Loss of in-stream habitat	Enhance Aquatic Refugia to improve instream habitat (improvement zones)	CMA	400	20 km of river with habitat improvement works	20 km of river identified as an ecologically healthy river.	*Waterway Management and Implementation Plan*

11.4 Yea River Reaches 54-57, and Murrindindi River Reach 59

The Yea River is a major stream in Management Unit U4. The Murrindindi River is a major tributary of the Yea River. All five reaches (91 km in total) are identified as having either poor riparian vegetation condition (Reaches 54, 55, 56 and 59 – 73.5 km) or stock access (All reaches). The Yea River (Reach 55) is identified as a High Priority Reach and actions in that reach (Table 9.12) will improve that reach to ecologically healthy condition. Actions under Program C will improve a significant proportion of the Management Unit to ecologically healthy river status.

Actions in the Yea (Reaches 54, 56 and 57) and Murrindindi Rivers (Reach 59) to improve them to ecologically healthy river status.

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Programs
C3	Degraded Streamside Zone and Stock access	Provide fencing and revegetation incentives.	CMA	1,307	142 km frontage fenced and revegetated	71 km of stream identified as an ecologically healthy river.	*Waterway Management and Implementation Plan*
C4		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	142 km frontage under CRP		
C5		Control grazing on public waterfronts	DSE, (CLM)	Program E	142 km of frontage controlled		

11.5 Acheron River Reach 63

The Acheron River is a major stream in Management Unit U6. Reach 63 in the Acheron River (27.5 km) is identified as having either poor riparian vegetation width and stock access. Combined with the actions for Acheron Reach 62 (Table 9.13), this will extend the status of ecologically healthy river to the entire Acheron River, covering 52.5 km of river. This will combine with the Taggerty River Reach 64 to raise the condition of the entire Acheron River catchment to ecologically healthy river status, a significant achievement.

Actions in the Acheron River Reach 63 to improve it to ecologically healthy river status.

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Programs
C6	Degraded Streamside Zone and Stock access	Provide fencing and revegetation incentives.	CMA	506	55 km frontage fenced and revegetated	27.5 km of stream identified as an ecologically healthy river.	*Waterway Management and Implementation Plan*
C7		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	55 km frontage under CRP		
C8		Control grazing on public waterfronts	DSE (CLM)	Program E	55 km of frontage controlled		

11.6 Rubicon River Reach 65

The Rubicon River is a major stream in Management Unit U6. Reach 65 in the lower section of the river (10 km) is identified as having either poor riparian vegetation width and stock access.

Actions in the Rubicon River Reach 65 to improve it to ecologically healthy river status.

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Programs
C9	Degraded Streamside Zone and Stock access	Provide fencing and revegetation incentives.	CMA	184	20 km frontage fenced and revegetated	10 km of stream identified as an ecologically healthy river.	*Waterway Management and Implementation Plan*
C10		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	20 km frontage under CRP		
C11		Control grazing on public waterfronts	DSE (CLM)	Program E	20 km of frontage controlled		

11.7 Howqua River Reaches 69 and 70 and Jamieson River

The Howqua River, upstream of Lake Eildon in Management Unit U7 is classified as a High Priority Reach, due to the Heritage River status of the river. While no threats were identified to the particular Heritage River values, riparian width and intactness were identified as the major deficiency to ecologically healthy river status. Again (as for Goulburn Reach 16), this seems unusual, given the nature of the upper catchment, and may reflect only the condition of the sites chosen for ISC assessment, so actions may not be required along the total length of the river.

Actions in the Howqua River Reaches 69 and 70 and Jamieson River to improve them to ecologically healthy river status.

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Programs
C12	Poor riparian vegetation	Provide revegetation initiatives	CMA	160	Up to 50 km of stream subject to revegetation works	50 km of stream identified as an ecologically healthy river.	*Waterway Management and Implementation Plan*

11.8 Holland Creek Reach 15

Holland Creek Reach 15 is the upper section (7.5 km) of Holland Creek in Management Unit M3 (Broken River Basin). The condition of the riparian vegetation prevents the reach being seen as an ecologically healthy river.

Actions in Holland Creek Reach 15 to improve it to ecologically healthy river status.

No.	Threat	Actions	Agencies	Cost ($'000)	Management Action Target	Resource Condition Target	Sub-Programs
C13	Poor riparian vegetation	Provide revegetation initiatives	CMA	24	7.5 km of stream subject to revegetation works	7.5 km of stream identified as an ecologically healthy river.	*Waterway Management and Implementation Plan*

12. Program D: Improvement to Other River Reaches

Program D involves general improvements to other reaches through improvements in riparian vegetation.

Across all environmental values, stock access, degraded streamside zone and introduced flora either affect the largest number of environmental values, and/or are a Very High or High risk threat in the most number of non-priority reaches (Table 7.2). Addressing these threats in a broad scale approach would seem to be the best strategy for protecting or improving the most number of environmental values in the Goulburn Broken Catchment.

Of the 1200 km of non-priority rivers in the Goulburn Broken Catchment, there are approximately 1100 km (92%) with uncontrolled stock access. About 500 km of non-priority rivers have a degraded streamside zone (all of which also have uncontrolled stock access). One hundred and thirty kilometers of non-priority stream length has a serious threat from exotic vegetation (not always associated with stock access). A list of river reaches with these conditions in shown in Table 12.1.

The Regional River Health Strategy will set a challenging target of rehabilitating the streamside zone over 20% of non-priority reaches by 2014 (200 km of stock control and 25 km of exotic vegetation control).

No.	Threat	Actions	Agencies	Cost ($,000)	Management Action Target	Resource Condition Target	Sub-Programs
D1	Exotic vegetation	Control exotic vegetation on streams	CMA	413	25 km of stream subject to riparian weed control	Improve ISC Streamside Zone sub-index by up to 8 points over 125 km river. Improve ISC Physical Form sub-index by up to 1 point over 100 km river.	*Waterway Management and Implementation Plan* *Willow Management Plan*
D2	Stock access and degraded streamside zone	Provide fencing and revegetation incentives.	CMA	3,680	400 km frontage fenced and revegetated		*Waterway Management and Implementation Plan*
D3		Encourage land managers to adopt CRP for "*Managing grazing in the riparian zone*"	DSE, CMA	Program F	400 km frontage under CRP		
D4		Control grazing on public waterfronts	DSE (CLM)	Program E	400 km of frontage controlled		

While the major proportion of funding will be directed towards projects identified within Programs A, B and C, the implementation of this program will assist in the objective of achieving an overall improvement in the environmental condition of rivers. This program will continue to support community based programs at the reach scale, where they contribute to stream health, and where ownership and community capacity is demonstrated (see Program F).

Table 12.1 List of non-priority river reaches where riparian threats form a Very High or High risk to some high value asset within the reach.

Stock Access				Degraded Streamside Zone		Exotic vegetation	
Goulburn Basin		Broken Basin					
Name	ISC Reach	Name	ISC Reach	Name	ISC Reach	Name	ISC Reach
Seven Creeks	17	Broken River	6	Ryans Creek	16	Five Mile Creek	7
Seven Creeks	18	Five Mile Creek	7	Watchbox Creek	19	Holland Creek	14
Faithfull Creek	21	Five Mile Creek	8	Hughes Creek	38	Sam Creek	18
Honeysuckle Creek	22	Lima East Creek	9	Sunday Creek	46	Watchbox Creek	19
Honeysuckle Creek	23	Lima East Creek	10	Sunday Creek	47	Winton Creek	20
Sheep Pen Creek	24	Sawpit Creek	11	King Parrot Creek	52	Nine Mile Creek	29
Castle Creek	25	Holland Creek	14	Murrindindi River	58	Pine Lodge Creek	30
Castle Creek	26	Sam Creek	18	Ford Creek	73	Boosey Creek	34
Creightons Creek	27	Watchbox Creek	19			Seven Creeks	18
Creightons Creek	28	Winton Creek	20			Faithfull Creek	21
Pranjip Creek	29	Broken Creek	27			Honeysuckle Creek	23
Cornella Creek	30	Nine Mile Creek	28			Sheep Pen Creek	24
Cornella Creek	31	Nine Mile Creek	29			Castle Creek	26
Yallagalorrah Creek	32	Pine Lodge Creek	30			Creightons Creek	28
Major Creek	35	Boosey Creek	33			Hughes Creek	38
Hughes Creek	38	Boosey Creek	34			Whiteheads Creek	40
Sugarloaf Creek	41	Sandy Creek	35			Kurkurac Creek	44
Molison Creek	42					Murrindindi River	58
Kurkurac Creek	44					Spring Creek	61
Sunday Creek	45					Ford Creek	73
Sunday Creek	46					Brankeet Creek	74
Sunday Creek	47					Merton Creek	75
Dabyminga Creek	49						
King Parrot Creek	52						
Murrindindi River	58						
Home Creek	60						
Spring Creek	61						
Ford Creek	73						
Brankeet Creek	74						
Merton Creek	75						

13. Program E: Preventing damage from inappropriate development

Numerous agencies in the Goulburn Broken Catchment have responsibilities for managing activities in the catchment that can affect river health (Table 13.1).

Table 13.1 Agencies and key responsibilities for managing development.

Agency	Primary river health responsibilities
Goulburn Broken Catchment Management Authority	Supply strategic direction for land and water resource management through Regional Catchment Strategy
	Development and review of Regional River Health Strategies
	Waterway, floodplain and rural drainage management
	Management of Heritage Rivers (outside of National Parks)
	Community education and involvement in river health management
	Preparation of water quality/nutrient management plans
	Implementation of river works for stabilising bed and banks, or habitat improvement
	Licensing of works on waterways
	Management of the Environmental Water Reserve
	Conducting environmental flows assessments
	Liaising with adjacent CMAs to ensure integration of efforts to protect cross-border assets.
Department of Sustainability and Environment (including Parks Victoria)	Supply strategic direction for all public land management
	Management of Heritage Rivers (inside of National Parks) and Ramsar sites
	Management and enhancement of crown water frontages
	Management of flora and fauna
	Development of Bulk Entitlement conversions
	Pest plant and animal control, excluding willows on other river frontages
Department of Primary Industries	Management of recreational and commercial fisheries
	Management of commercial forestry and the *Code of Forest Practices*
	Management of broad catchment management issues (e.g. salinity) and agricultural services
	Management of extraction of river gravels and sands, and management of the impacts of past and current mines.
Environment Protection Authority	Production of *State Environment Protection Policies*
	Licensing of sewage and other discharges to waterways.
	Enforcement role to ensure adequate compliance with state policies at the local level.
Goulburn Murray Water	Management of supply of water from surface and groundwater supplies for irrigation and rural stock and domestic use.
	Implementation of environmental water reserve.
	Planning and development of Streamflow Management Plans.
Goulburn Valley Water / NERWA	Management of urban water supply.
	Management of urban wastewater disposal.
Local Shires	Implementation of Planning Scheme controls relating to development on Crown land and adjoining private land.
	Management of rural drainage schemes
	Maintaining the security of infrastructure, including bridges and roads.

Many agencies are also involved in activities that, while not directed at managing river health, may have impacts of the condition of rivers and streams, such as fire management and road maintenance. Under Program E, each agency will conduct an internal review of activities, co-ordinated by the CMA, to identify all activities that might influence river health, and ensure that activities are consistent with the goals of the Regional River Health Strategy.

Actions for Program E: Preventing damage from inappropriate development and other activities

No.	Action	Agencies	5 year Cost ($,000)
E1	Review connections between agencies with regard to co-ordinating river health regulation and management. Develop appropriate arrangements between the Authority and each agency to facilitate the effective management of river health	CMA	100
E2	Develop and implement an agency education and awareness campaign to ensure agency understanding and knowledge about river health issues	CMA	500
E3	Review agency activities with regard to river health implications.	CMA	20
E4	Initiate agency activities with regard to river health implications	All	Not costed

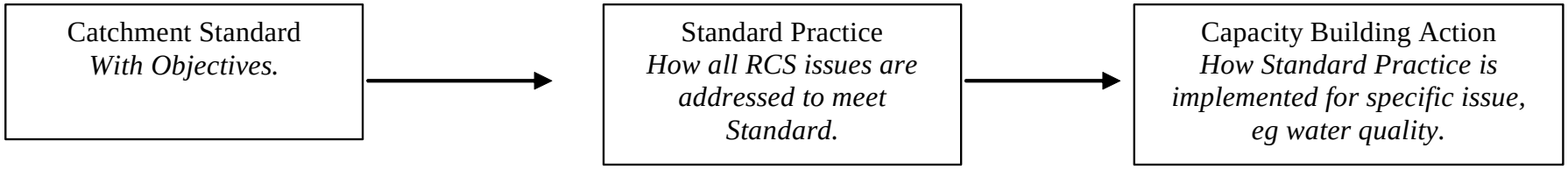
14. Program F: Engagement and Building Capacity

Any improvement in the condition of the Goulburn Broken rivers can only occur if regional communities are fully engaged and committed through their participation and capacity to become involved.

The objectives of the Regional River Health Strategy will only be achieved if the community has the capacity to do so. The GBCMA has adopted an Engagement and Capacity Building Objective to:

> *… ensure that the River Health Program has the capacity to implement all priority actions that contribute to the Implementation and Resource Condition Targets set within the River Health Strategy*

To achieve this overall objective, the GBCMA has developed a set of "Catchment Standards" with "Standard Practices" for managing all issues directed towards building and maintain capacity. The Standards group is the essential components for ease of management. Of course, the individual Standards and Objectives are not mutually exclusive, which is typical with attempts to isolate components when holistically managing very complex systems.



The River Health and Water Quality Committee (RHWQC) is responsible for overseeing implementation of all Capacity Building Actions (Table 14.1), many of which will be performed by the three Implementation Committees through their respective Waterway Working Groups.

Table 14.1 Actions under Program F – Engagement and Building Capacity

Catchment Standard Objective	Standard Practice	Regional Catchment Tasks	Action	10 Year Cost ('000)	Priority	Milestone Time frame	Agencies
People Partnerships supported (agency and community) *Ensure key agencies, community organisations, and private industry organisations adopt the RHS by including its principles and priorities in their own strategies and programs.*	Actively involve key stakeholder groups to be represented on key decision-making forums.	Maintain appropriate representation through existing Catchment processes such as: Implementation Committees, Co-ordination Committees and Waterway Working Groups	Community members with expertise in riverine health issues to be represented on Coordinating Committees, Implementation Committees and Waterway Working Groups.	200	1	Annual	Catchment Management Authority (CMA), River Health and Water Quality Committee (RHWQC), Implementation Committees (IC's), Waterway Working Groups (WWG's)
	Encourage private industry sponsorship in natural resource management.	List opportunities for investment in natural resource management and prepare prospectuses.		50	2	2005/6	IC's
	Promote adoption of the RHS by community organisations and agencies.	Include RHS principles and priorities in related programs (including biodiversity, salinity, pest plant and animals, local government).		50	1	2005/6	RHWQC
	Employ key people in appropriate organisations to help regional and local action planning groups to develop Catchment priorities.	Develop synergies by reviewing staffing arrangements in all organisations, recognising that some staff are dedicated to working solely on specific issues while many others contribute via integrated programs.	Review co-ordination and partnership arrangements for Riverine Health, with emphasis on roles of GMW, GBCMA, DSE and DPI. Progress indigenous employment and participation opportunities.	10		2005	CMA, RHWQC, DPI / DSE, EPA, Local Government, GMW, Urban Water Authorities
	Promote awareness of natural resource management issues in a targeted way.	Continuously update and implement the GBCMA's Communications Strategy,	Prepare Communications Strategy for Riverine Health.	40	1	2005	RHWQC (with support of IC's / WWG's)
			Implement Communications Strategy	500	1	2010	
	Maintain linkages with Commonwealth and state forums to strengthen understanding of issues and roles in partnerships.	Revise Regional Catchment Strategy by 2009 with agreement by State and Commonwealth.	Revise Riverine Health Strategy and Action Plans by 2009 with agreement by State and Commonwealth	100	1	2009	RHWQC
	Provide a range of opportunities for community involvement in River Health and Water Quality Program	Maintain current mix of potential activities such as Riparian grants, incentives and funding for programs such Waterwatch and Landcare. Identify opportunities for increasing and optimising opportunities for targeted groups and individuals to have involvement in meeting RHP objectives		(inc in other costs)	1	Annually	CMA/GVW/GMW/Local Gov/DSE
Fairness: equitable sharing of costs and benefits *Ensure all stakeholder costs and benefits in natural resource management are identified so that appropriate levels of investment are made.*	Promote equitable sharing of costs for implementing the RHS to encourage accountability (appropriate individuals / organisations pay the appropriate share) & targeting (participation in areas where it is needed most).	Develop consistent, objective methods for valuing the ecosystems, considering social, cultural, economic and environmental values. Identify all contributions (costs) borne by partners in natural resource management. Develop a process for measuring the full range of benefits and the rationale for investment in natural resource	Maintain knowledge and understanding of progress. Integrate into program, as new information is available.	50	1-2	On-going	RHWQC CMA

Catchment Standard Objective	Standard Practice	Regional Catchment Tasks	Action	10 Year Cost ('000)	Priority	Milestone Time frame	Agencies
		management. Build on the multi-benefit approach to grants for landholders so that it covers all programs of the GBCMA. Identify mutually beneficial projects for greenhouse gas control and biodiversity.					

Catchment Standard Objective	Standard Practice	Regional Catchment Tasks	Action	10 Year Cost ('000)	Priority	Milestone Time frame	Responsibility
Cultural heritage valued *Ensure cultural heritage values of significant sites/ places/ landscapes are always considered in managing natural resources.*	Promote consideration of cultural heritage values in all stages of natural resource management planning.	Include cultural heritage values in project proposal checklists. Identify significant places and their cultural heritage values. Include cultural heritage values in multiple benefits approach to allocating resources.	Identify sites of significance within riverine environment. Include values within prioritisation processes. Recognise cultural and heritage values in program development	100	1	2005	RHWQC
Information Targeted *Ensure resources are invested so that the optimal return is achieved according to an agreed set of priorities and principles for priority setting.*	Promote balanced investment in natural resource management using Catchment-scale goals and maps as a guide.	Develop short-term targets and steps to achieving them for all issues based on long-term (20-50 year) goals and integrate these into Implementation Committee business plans.	Include Statewide decision frameworks into prioritisation development. Include regional decision frameworks into prioritisation development.	50	1	2005	RHWQC, IC's
Technically rigorous *Ensure decisions are made based on best available economic, sociological, and scientific understanding of the Catchment.*	Promote balanced investment in natural resource management using best available economic, sociological, and scientific understanding.	Compile an inventory of assets, identify management opportunities including costs and benefits, and develop a plan to ensure that investment is appropriate.	Compile an inventory of riverine assets / values, threats and management opportunities, to develop a plan to ensure that investment is appropriate. Determine the requirements of riverine ecosystems, associations or key species threatened by changes in hydrology or management practices. Determine the hydrological requirements of natural processes in key riverine ecosystems. Describe the factors causing degradation of riverine ecosystems, and their effects on natural riverine processes.	50	1	Ongoing Review in 2009	RHWQC

	Ensure adequate risk analysis for on-ground works.	Use bioregional planning information to inform decision-makers of natural ecosystem needs. Develop a program to consider social and economic needs together with cultural and heritage values	Adoption of Statewide Decicion Support process.				
	Promote a systematic and agreed approach to custodianship of data, including management and exchange.	Include data custodianship agreements in all projects.	Develop process for data storage and retrieval	40	2	2005/6	CMA, DPI, DSE, GMW

Catchment Standard Objective	Standard Practice	Regional Catchment Tasks	Action	10 Year Cost ('000)	Priority	Milestone Time frame	Responsibility
Systems Planning Multiple benefits of integrated planning *Ensure all levels of planning are linked and all issues are integrated.*	Promote a Catchment-scale approach to policy development, with an emphasis on a close linkage between policy development and implementation.	Include all Catchment-wide stakeholders in the business planning process, including Goulburn-Murray Water, DPI/DSE, Flora and Fauna, Forests Management, Land Victoria, and Parks Victoria.	Identify Values and Threats to River Health on Management Unit basis.	10	1	ongoing	CMA
	Promote the use of Local Area Plans to articulate what local communities want to achieve. Promote the development and integration of agency business and local area planning initiatives using appropriate technical information.	Include resource condition goals based on the RHS goals in Local Area Plans, River Health Plans.		(In-kind)	1 - 2	Annually	CMA, IC's and partners
		Ensure future funding arrangements reflect the priorities of this RHS.					
Land-use matching land capability at broad scale *Achieve large-scale land-use change so that land-use is better matched with land capability.*	Promote large-scale land-use change so that land-use better matches land capability.	Identify areas for which the land-use is no longer appropriate. Develop alternative management options for large tracts of land.	Investigate Lower Goulburn Floodplain for potential change in land-use. Investigate other areas where change is required. Review license arrangements on Heritage Rivers and Crown Water Frontages.	100	1	2006	RHWQC, IC's and WWG's
Best practice management by individual and groups of land managers *Ensure natural resources are managed according to best practice.*	Focus on a Best Management Practice (BMP) approach to natural resource management on all land tenures, including private land, leased public land, land managed by utilities, and roadsides.	Establish best management practices for priority native ecosystems under different land tenures.	Expand methodology developed under Land & Water Australia R&D project on riparian grazing BMPs to other issues.	50	1	2005-2010	RHWQC, DSE, Local Government
			Promote the functions of riparian lands.	50	1		
			Initiate Rural Real Estate / River Stewardship Program.	50	1		

15. Program G: Monitoring, Evaluation and Reporting

Monitoring - the systematic collecting and storing of data to enable activities, projects, programs, plans and strategies to be evaluated and reported. Monitoring includes measurement of the level of activity (output) and change (outcome).

Evaluating – assessing an outcome or activity against a stated goal, objective or value.

Reporting - the documenting of results of monitoring and evaluation and presenting to the appropriate forum (or audience) at specified times.[32]

Actions and targets listed in this *River Health Strategy* will be monitored, evaluated and reported back to key partners and the community, together with any recommendations for changes and additions, under the adaptive management framework. The key to successful adaptive management systems is for information from monitoring and evaluation to feedback clearly into decision-making processes. The GBCMA provides guidance for any natural resource management issue in its *Monitoring, Evaluation and Reporting Strategy for the Goulburn Broken Catchment (2004)*.

An effective monitoring, evaluation and reporting (MER) program is essential to ensure that the actions outlined under the Regional River Health Strategy lead to the achievement of both the management action or implementation targets and the resource condition targets.

The precise design of the MER program is beyond the scope of this strategy. A number of actions also need to be refined before a detailed monitoring program can be designed (e.g. decisions on environmental flows downstream of Goulburn Weir, environmental objectives in Management Unit M1 – Eildon to Goulburn Weir). Therefore, a flexible program shall be designed as an integral part of the works planning for the implementation of the Regional River Health Strategy. The monitoring program design will be guided by the actions and principles outlined in *Monitoring, Evaluation and Reporting Strategy for the Goulburn Broken Catchment (2004)* produced by the GBCMA.

It is strongly recommended that the MER program is developed within a timeframe which allows for assessment of the current condition prior to the implementation of the upcoming programs.

[32] Adapted from GBCMA (2004) *Monitoring, Evaluating and Reporting Strategy for the Goulburn Broken Catchment.* Goulburn Broken Catchment Management Authority, Shepparton.

Table 15.1 Actions under Program G – Monitoring, Evaluation and Reporting

No.	Action	10 Year Cost ('000)	Priority	Milestone Time frame	Responsibility
Objective: Report progress in river health in a clear and meaningful way					
G1	Promote a monitoring, evaluating and reporting framework that emphasises the link between those making the changes (implementers) and those at Catchment, State and national levels Support regional partnership initiatives (North East Regional Water Quality Monitoring Partnership) Promote and support opportunities for community involvement in monitoring the health of the region's waterways through Waterwatch and other community processes.	50 (included in WQ costs)	2 1	Annually	CMA and IC's CMA, GVW DSE, DPI, EPA and GMW
Objective: Ensure Strategy implementation is monitored and underlying assumptions are regularly reviewed and appropriate modifications made.					
G2	Establish a program that monitors via CMA Implementation Committees: • Resource (or Catchment condition) condition changes • Management Objectives and Strategies achievement • Management Task (output) achievement • Physical target (output) achievement • Evaluate the RHS implementation at least annually (Implementation Targets) , and prepare an Annual Report that shows progress on issues by Implementation Committee and whole of Catchment scales. • Evaluate the RHS effectiveness every five years (Resource Condition Targets) • Monitor impact of Environmental Water Reserve.	100	1	2009	CMA, RHWQC and IC's

Guidelines for Monitoring and Evaluation Program

Program A - Protection and Enhancement of High Priority Reaches

For many of the actions for Program A, the targets for threat reduction are expressed as an increase or change in the ISC score for various environmental assets, particularly the physical and riparian components. Therefore, the monitoring program for threats can be incorporated into the regular ISC monitoring of these reaches. However, additional monitoring between regular ISC assessments are suggested (with one set of assessments between each 5 year regular assessment). The comparison of current and future ISC scores (in relation to the target) represents a simple monitoring program for these features.

Monitoring the high value environmental assets require more careful evaluation. Table 15.2 shows the primary environmental assets in each Management Unit identified for protection. Social and non-environmental assets that have been identified as high value in each Management Unit, such as European Heritage values, fishing opportunities etc., are not included here (although these will need to be monitored).

These environmental assets fall into four main categories:

- Condition of floodplain vegetation along the main Goulburn River;
- Species composition of native fish downstream of Goulburn Weir;

- The presence and sustainability of a number of individual species (Murray cod, Silver perch, Macquarie perch, Trout cod, Spotted tree frog and Alpine bent); and
- Wetland condition.

Monitoring floodplain vegetation condition falls under the responsibility of the Goulburn Broken Native Vegetation Management Strategy 2000. Monitoring of Trout cod and Spotted tree frog populations will be conducted under the National Recovery Plan process for these species. Monitoring of the condition of wetlands of national and international importance is covered in the Wetlands Strategy. A monitoring program for native fish diversity downstream of Goulburn Weir will be developed in the implementation phase of the Goulburn environmental flow project.

A monitoring program therefore needs to be designed for the condition of Murray cod, Silver perch, Macquarie perch and Alpine bent in various reaches of the catchment. An approach based on comparison with a target (reference) condition is recommended, based on the size and age distribution of the fish species. For Alpine bent, a survey needs to be conducted to establish the range of the species, and recruitment of the species needs to be monitored.

Table 15.2. Key environmental assets for monitoring under Program A – Protection of High Priority Reaches

Management Unit	Key environmental assets for protection	Key monitoring components
L1 – Lower Goulburn River	Heritage River (forest communities, native fish diversity); Wetlands of national significance; Murray cod and Silver perch populations.	Condition of significant forest communities; Species composition of native fish community; Size and age distribution and annual recruitment of Murray cod and Silver perch; Wetland condition.
L2 – Lower Broken Creek	Ramsar and wetlands of national significance; Murray cod populations.	Size and age distribution and annual recruitment of Murray cod; Wetland condition.
L4 – Western Tributaries	Wetlands of national significance	Wetland condition.
L5 – Lower Broken River	Wetlands of national significance; Murray cod and Silver perch populations.	Size and age distribution and annual recruitment of Murray cod and Silver perch; Wetland condition.
M1 – Mid Broken River	Macquarie perch and Murray cod populations.	Size and age distribution and annual recruitment of Murray cod and Macquarie perch.
M2 – Upper Broken River	Macquarie perch and Murray cod populations.	Size and age distribution and annual recruitment of Murray cod and Macquarie perch.
M3 – Ryans and Holland Creeks	Macquarie perch populations.	Size and age distribution and annual recruitment of Macquarie perch.
M6 – Broken and Boosey Creeks	Wetlands of national significance	Wetland condition.
M7 – Euroa Strathbogie	Trout cod and Macquarie perch populations.	Size and age distribution and annual recruitment of Trout cod and Macquarie perch
U1 – Mid Goulburn River	Heritage River	No monitoring program required until objectives for the reaches are set.
U2 – Major Creek and Hughes Creek	Macquarie perch and Murray cod populations.	Size and age distribution and annual recruitment of Murray cod and Macquarie perch.
U4 – King Parrot Creek/Yea River	Macquarie perch populations.	Size and age distribution and annual recruitment of Macquarie perch.
U6 – Acheron River	Representative River; Barred galaxias.	General ecological condition; Size and age distribution and annual recruitment of Barred galaxias
U7 – Upper Goulburn catchment	Heritage River; Representative River; Macquarie perch, Murray cod and Barred galaxias populations; Spotted tree frog populations; Alpine bent populations.	General ecological condition; Presence, size and age distribution and annual recruitment of Murray cod, Barred galaxias and Macquarie perch. Presence, size and age distribution and annual recruitment of Spotted tree frog. Distribution and recruitment of Alpine bent.

Program B - Protection of Ecologically Healthy Rivers

Monitoring for Program B is aimed at ensuring that the 5 river reaches identified maintain ecologically healthy river status into the future. Monitoring ecologically healthy river reaches involved two components:

- the riparian vegetation measures (width and continuity), in-stream measures (bed stability, bank stability, channel modification, streamside zone, in-stream habitat and stock access) and Flow Deviation that form the basis for the selection of ecologically healthy rivers in the Goulburn Broken Catchment (Appendix 8); and
- a biological component of in-stream fauna representative of an ecologically healthy river.

The first component are all ISC measures, and monitoring of these can be done as part of the regular ISC monitoring program.

For the second component, monitoring of aquatic macroinvertebrate communities is recommended. Aquatic macroinvertebrates are widely used in Australian monitoring programs primarily because they respond to changes in environmental condition in a relatively short time frame (and so should provide an early warning indicator for reduction in ecological health). The main measure of macroinvertebrate community composition is the AUSRIVAS score, and this should be checked every few years in ecologically healthy river reaches.

Program C – Creating More Ecologically Healthy Rivers

Monitoring for Program C (13 reaches) is aimed at measuring the improvement in condition to ecologically healthy river status. As such, the same MER program as designed for Program B is appropriate, with the addition of works program monitoring and threat abatement monitoring (ISC).

Program D - Improvement to other rivers

In Program D, 20% of non-priority river reaches with degraded riparian zones will be rehabilitated. Monitoring, evaluating and reporting of these will be through the ISC program.

Program E– Preventing damage from inappropriate development and other activities

Each agency is responsible for developing MER programs for their own management activities.

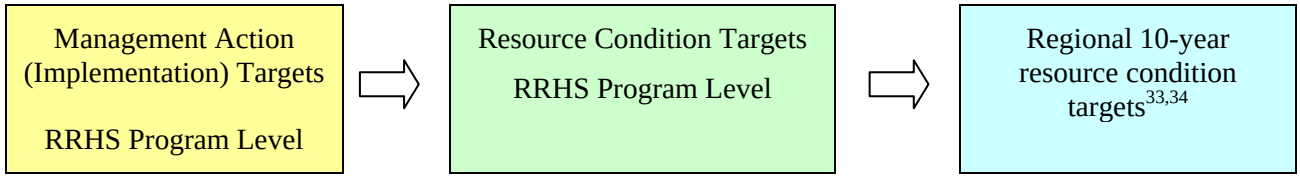
16. Targets and Implementation Costs for the Regional River Health Strategy

16.1 Targets

The Victorian River Health Strategy identifies a range of targets for the protection and enhancement of river health (Appendix 19). Collectively each CMA will be able to measure their contribution to regional and State-wide targets, which have been set for river health. Targets set within this strategy aim to align and contribute towards the stated targets.

Achievement of the "Regional 10-year resource condition targets and their contribution to State-wide targets are reliant on the effective delivery of Management Action (Implementation) Targets and their successful progression towards the stated Resource Condition Targets within each RRHS program (see Section 16.3 – 16.8).

When linking Management Action Targets and Resource Condition Targets we rely on the associated assumptions, as shown in Appendix 13. The hierarchy of target levels developed within this strategy follow:



The hierarchy, shown above, is simplified as often an individual Management Action Target may often contribute to a range of resource condition targets. Similarly it may, in some instances require the contribution from a number of actions in order to deliver on improvement or protection of the resource. Hence a linear hierarchy for each MAT and RCT, from Tables 18.3-18.8, cannot be displayed. An example of the individual contribution of a single Management Action Target to a range of Resource Condition target follows:

Management Action Target	Link to Resource Condition Target (eg…)
Length of frontage fenced and revegetated with native species, under CRP for "*Managing grazing in the riparian zone*" and with grazing controlled	Improvement in ISC Streamside Zone sub-index. Improvement in ISC Physical Form sub-index. Long term improvement in ISC Aquatic sub-index. Reduction in phosphorous contribution to the stream and exports from the Goulburn Broken Catchment. Improvement and protection of high quality native vegetation Support habitat for aquatic and terrestrial faunal species Protection of heritage and representative values

Regional 10-year resource condition targets, derived from the Management Action Targets and Program Resource Condition Targets, follow in Table 16.1

[33] Ten year regional (GBCMA) Resource Condition Targets are based on the summation of overall program Resource Condition Targets.
[34] Targets for the protection and enhancement of river health – from the Victorian River Health Strategy.

Table 16.1 – Regional Targets (Goulburn Broken Catchment)

Implementation Targets RRHS Program Level	Resource Condition Targets - RRHS Program Level	Ten (10) year Regional Resource Condition Targets
		350km of river maintained in excellent or good condition (as measured by ISC#) (1999 benchmark)
		Establishment of Environmental Water Reserve and improve flow regimes achieving flow objectives in 6 high value rivers (21 reaches).
		Reduction/improvement in nutrient loads at key monitoring sites within catchments[35] Reduction in phosphorous exports of 2375 kg/year at Gauge 405204, 1050 kg/year at Gauge 404210, 312.5 kg/year at Gauge 404224, 312.5 kg/year at Gauge 404216, 50 kg/year at Gauge 404207, 225 kg/year at Gauge 404214, 190 kg/year at Gauge 405237 and 250 kg/year at Gauge 405231 Contribute to overall 65% reduction below 1996 levels
		550km of river with protection/improvement in riparian condition (as measured by ISC#)
		550km of river with protection/improvement of physical form subindex (as measured by ISC#)
		Estimated 140km of river where instream habitat has been enhanced / reinstated
		Estimated 225km increase in river length made accessible for fish movement
		5 reaches of stream with Ecologically Healthy River status maintained over 112 km of river. 4 Representative rivers/reaches maintained in good or excellent condition (as measured by ISC#)
		Value of Heritage Rivers maintained
		**Protection/improvement of aquatic life (as measured by ISC#) at key monitoring sites (note that key sites must be clearly defined)
Targets to be developed by 2007/08		Reduction/improvement in salinity loads/concentrations at key monitoring sites within the catchments (note that key sites must be clearly defined)
		Reduction/improvement in sediment loads/concentrations at key monitoring sites within the catchments (note that key sites must be clearly defined)
		*% of relevant SEPP (WoV) objectives met for key monitoring sites (note that relevant objectives and key sites must be clearly defined)

16.2 Program Costs

The aim of the Regional River Health Strategy is to develop priority actions for river health activities across the region. These will be implemented by a range of partners including CMAs, DPI, EPA, DSE, Local Government, Water Authorities and the community. The indicative costs for implementing these activities are included in the strategy. The indicative costs relate primarily to the costs for the Catchment Management Authorities, with support from partnership agencies and the community, to implement river health activities as per their responsibilities as statutory waterway managers and caretakers of river health. River Health related activities undertaken by other agencies such as Water Authorities, DPI, Local Government and DSE and associated costs have been identified and documented wherever possible. In addition, it is important to recognise the role that other action plans

[35] Based on a reduction of 2.5 kg/km/yr total phosphorous due to fencing and revegetation (see Assumptions in Appendix 14).

and sub-strategies under the Regional Catchment Strategy play in contributing to Regional River Health Strategy outcomes which are not directly costed or implemented under this strategy.

The overall cost of the program for all priority actions is estimated at $125,000,000 over the ten year life of this strategy. To effectively deliver the priority actions under this strategy an annual expenditure in the order of $12,000,000 is required across the range of programs and implementation agencies and regional stakeholders (riparian landowners, local government, statutory authorities - see Chapter 18).

The total cost of implementing the Regional River Health Strategy includes on-ground actions, strategic planning, community engagement, regional partnerships and monitoring, evaluation and reporting. Implementation of the Strategy will rely on continuing learning, data collation and investigations into the health of the region's rivers and the strong support of the community and land managers. Monitoring and evaluation programs are required to enable a true adaptive management approach.

It should be noted that specific reference to funding levels and proposed cost shares in this strategy are for indicative purposes only. The level of Government investment in this strategy is contingent on budgets and Government priorities. Program costs are summarised in Table 16.2. Detail of each program in shown in Sections 16.3 – 16.8.

Table 16.2 – Indicative Program Costs

Program	**Program Objective**	**Cost ($',000s) (2005-2015)[36]**
Program A: Protection and Enhancement of High Priority Waterways	Protect and enhance identified high value environmental, social and economic assets over 1,060.5 km of river	$113,300
Program B: Protection of Ecologically Healthy Rivers	Ecologically Healthy River status maintained over 112.5 km or river	$1,000
Program C: Creating More Ecologically Healthy Rivers	286 km of river improved to Ecologically Healthy River status	$3,990
Program D: Improvement to other rivers	Rehabilitation of the streamside zone over 20% of non-priority reaches by 2014	$4,093
Program E: Preventing damage from inappropriate development	No decline in river health condition due to inappropriate development	$0.6
Program F: Engagement and Capacity Building	Ensure that the Goulburn Broken community has the capacity to implement all priority actions that contribute to the objectives of the Regional River Health Strategy	$1,500
Program G: Monitoring, Evaluating and Reporting	An effective monitoring, evaluation and reporting program developed and implemented.	$1,150

[36] Cost-sharing principles for the implementation of the Strategy are summarised in Section 19.1.

16.3 Program A: Protection and Enhancement of High Priority Waterways

Overall target for Program A:

Protect and enhance identified high value environmental, social and economic assets over 1,060 km of river

Management Action Target	Resource Condition Target	Indicative Cost $
Riparian Management		
1,236 km frontage fenced and revegetated with native species, under CRP for "*Managing grazing in the riparian zone*" and with grazing controlled	Improvement in ISC Streamside Zone sub-index by up to 8 points over 425.2 km river. Improvement in ISC Physical Form sub-index by up to 1 point over 425.2 km river.	11,372,000
65 km of stream with banks stabilised and under CRP for "*Stabilising bed and banks*".	Improvement in ISC Physical Form sub-index by 1 points over 32.5 km of river	300,000
In-stream Works		
285.5 km of river with habitat improvement works or in-stream erosion control	Improvement in ISC Physical Form sub-index by 1 point over 144.2 km of river	4,166,000
Pest Plant and animal management		
210.5 km of stream subject to riparian weed control	Improvement in ISC Streamside Zone sub-index by up to 7 points over 105.7 km of river	2,529,000
Control and manage introduced species under the Murray Darling Basin Native Fish Management Strategy	Contribute to an overall enhancement of stream health and water quality	Costed in MDBC Strategy
38 km of stream subject to rabbit control	Rabbit population significantly reduced over 38 km of stream	Funded elsewhere
Environmental Water Reserve		
Goulburn environmental flow project completed and negotiated environmental flow regime implemented.	Establish Environmental Water Reserve and improve flow regimes on 21 high value river reaches.	50,000
Goulburn Bulk Entitlement Reviewed and amended as appropriate		50,000
Goulburn Weir Operating procedures reviewed and amended as appropriate.		10,000
Broken Creek environmental flow project completed and negotiated environmental flow regime implemented.		100,000
Management of Rice's Weir and associated fishway co-ordinated with environmental water requirement of Goose's Swamp.		20,000
King Parrot Creek Streamflow Management Plan completed and negotiated environmental flow regime implemented.		150,000
Flow plan developed for the Broken River	As determined by Flow Plan	150,000
Flow deviation data in Wanalta Creek reviewed	As determined by review	5,000
Water Quality Management[37]		
Minimise nutrient run-off into irrigation drains by implementation of on-farm BMP by irrigators as outlined in the Irrigation Drainage Program of the Water Quality Strategy	Reduction in phosphorous exports of 84.5 tonnes per year from the Shepparton Irrigation District.	60,000,000

[37] "Reduction improvement in nutrient loads/concentrations at key monitoring sites within catchments as detailed in Section 9…"

Water Quality Management[38]		
Remove phosphorous from irrigation drains through water re-use, sediment removal and nutrient stripping, as outlined in the Irrigation Drainage Program of the Water Quality Strategy.		
Minimise nutrient discharge to rivers by reducing nutrient generation to wastewater facilities, and from wastewater sources by disposal to land and/or improved treatment.	80% reduction below 1996 levels in total phosphorous exports from wastewater facilities.	0
Implement BMP for urban drainage as outlined in the Urban Stormwater Management Program of the Water Quality Strategy.	Reduction in phosphorous exports of 9.84 tonnes per year from the Goulburn Broken Catchment.	7,490,000
See also riparian management and In-stream works targets.	Reduction in phosphorous exports of 3,965 kg/yr from fencing and revegetation initiatives	Costed above
Develop other Water Quality Targets (salinity/suspended solids) by 2007/08	% of relevant SEPP (WoV) objectives met for key monitoring sites. (TBD through ERA process as identified.)	Costed above
	Reduction/improvement in salinity loads/concentrations at key monitoring sites within the catchments (TBD) Reduction/improvement in sediment loads/concentrations at key monitoring sites within the catchments (TBD)	Costed above
Fish passage management		
Two fishways installed or barriers removed at Gowangardie and Casey's Weirs.	225 km of stream open to fish passage	1,500,000
Floodplain Management		
Enhance floodplain to river linkages over 30 km of stream.	Improvement in ISC Wetland connectivity rating by 2 points over 30 km of river	25,000,000
Value of Heritage Rivers, Representative Rivers		
Protection of Heritage River Status Protection of Representative River Status	Value of Heritage Rivers and Representative River status maintained.	(costed above)
Investigations		
Ecological Risk Assessment conducted in 7 Management Units (9 reaches)	As determined by Risk Assessment	270,000
Conduct deliberative forum with CMA, major stakeholders and community representatives to establish clear achievable environmental objectives for the Goulburn River between Eildon Reservoir and Goulburn Weir	Establishment of clear management objectives for the Goulburn River	25,000
Assess impact of Lake Nillahcootie on downstream temperature regimes.	As determined by investigation	5,000
Explore opportunities to provide fish passage at Lake Nillahcootie	As determined by investigation	5,000
Assess causes of channel modification (de-snagging or alignment) in 3 Management Units and prepare appropriate management actions	As determined by investigation	15,000
Explore opportunities to provide fish passage at Goulburn Weir	As determined by investigation	50,000
Refine Sednet Model for water quality	No target	80,000
	Total	**113,342,000**

[38] "Reduction improvement in nutrient loads/concentrations at key monitoring sites within catchments as detailed in Section 9…"

16.4 Program B: Protection of Ecologically Healthy Rivers

Overall targets for Program B: Ecologically Healthy River status maintained over 112 km or river (good/excellent condition)

Management Action Target	Resource Condition Target	Indicative Cost $
Environmental condition monitored over 112.5 km of river	Ecologically Healthy River maintained over 112 km of river	Funded under Program G
Any observed decline in condition investigated and reversed.		Not costed
All development regulated to prevent any decline in environmental condition.		Funded under Program E
Works and Actions to maintain environmental condition of 112.5 km of river		$1,000,000

16.5 Program C: Creating More Ecologically Healthy Rivers

Overall targets for Program C: 286 km of river improved to Ecologically Healthy River status

Management Action Target	Resource Condition Target	Indicative Cost $
Up to 30 km of river with exotic vegetation controlled and revegetated with native species	30 km of river (upper Goulburn River) identified as an ecologically healthy river.	Up to 495,000 (Funded under Program A)
Up to 57.5 km of stream subject to revegetation works	50 km of stream (Howqua River) identified as an ecologically healthy river. 7.5 km of stream (Holland Creek) identified as an ecologically healthy river.	184,000
25 km of river with habitat improvement works	25 km of river (Bylands Creek) identified as an ecologically healthy river.	500,000
20 km of river with habitat improvement works	20 km of river (Dry Creek) identified as an ecologically healthy river.	400,000
307 km frontage fenced and revegetated, under CRP for "*Managing grazing in the riparian zone*" and with grazing controlled.	91 km of stream (Yea and Murrindindi Rivers) identified as an ecologically healthy river. 52.5 km of stream (Acheron River) identified as an ecologically healthy river. 10 km of stream (Rubicon River) identified as an ecologically healthy river.	2,411,000 (414,000 funded under Program A)
	Total	**3,990,000**[39]

16.6 Program D: Improvement to other rivers

Overall targets for Program D:

Rehabilitation of the streamside zone over 20% of non-priority reaches by 2014.

Management Action Target	Resource Condition Target	Indicative Cost $
25 km of stream subject to riparian weed control	ISC Streamside Zone sub-index improved by up to 8 points over 125 km river. ISC Physical Form sub-index improved by up to 1 point over 100 km river.	413,000
400 km frontage fenced and revegetated, under CRP for "*Managing grazing in the riparian zone*" and with grazing controlled.		3,680,000
	Total	**4,093,000**

[39]Includes $909,000 funded under Program A

16.7 Program E: Preventing damage from inappropriate development

Overall target for Program E:

No decline in river health condition due to inappropriate development.

Management Action Target	Resource Condition Target	Indicative Cost $
Review of activities conducted by agencies with river health responsibilities conducted	Agency roles and responsibilities clearly defined; Communications between agencies optimised; Staffing synergies between agencies developed; Targeted awareness campaign developed and implemented. No decline in river health condition due to inappropriate development	20,000
Connections between agencies with river health responsibilities conducted and appropriate arrangements between the Authority and each agency developed.		100,000
Agency education and awareness campaign developed and implemented.		500,000
	Total	**620,000**

16.8 Program F: Engagement and Capacity Building

Overall target for Program F:

Ensure that the Goulburn Broken community has the capacity to implement all priority actions that contribute to the objectives of the Regional River Health Strategy.

Management Action Target	Resource Condition Target	Indicative Cost $
Ensure key agencies, community organisations, and private industry organisations adopt the RHS by including its principles and priorities in their own strategies and programs	20% increase in the participation of the community in river health management programs. 20% increase in the adoption of Current Recommended Practices in the Goulburn Broken catchment (see Appendix 12) 25% increase in community monitoring sampling frequency across the region	950,000
Ensure all stakeholder costs and benefits in natural resource management are identified so that appropriate levels of investment are made.		50,000
Ensure cultural heritage values of significant sites/ places/ landscapes are always considered in managing natural resources.		100,000
Ensure resources are invested so that the optimal return is achieved according to an agreed set of priorities and principles for priority setting.		50,000
Ensure decisions are made based on best available economic, sociological, and scientific understanding of the Catchment.		90,000
Ensure all levels of planning are linked and all issues are integrated.		10,000
Achieve large-scale land-use change so that land-use is better matched with land capability.		100,000
Ensure natural resources are managed according to best practice.		150,000
Ensure a range of opportunities for community involvement in RHP		(costed above)
	Total	**1,500,000**

16.9 Program G: Monitoring, Evaluating and Reporting

Overall target for Program G:

An effective monitoring, evaluation and reporting program developed.

Management Action Target	Resource Condition Target	Indicative Cost $
Monitoring, evaluating and reporting framework promoted	n.a.	50,000
Monitoring, evaluation and reporting program developed		100,000
	Total	**150,000**

Implement an effective monitoring, evaluation and reporting program developed.

Management Action Target	Indicative Cost $
Implementation of Monitoring, evaluating and reporting framework.	1,000,000
Total	**1,000,000**

16.10 Contributions to the River Murray

Many of the actions in the Goulburn Broken River Health Strategy contribute to achieving the vision and aims of the Action Plan for the River Murray between Yarrawonga and Echuca (Earth Tech, 2002). These are detailed in Table 16.1.

Table 16.1. Contributions from the Regional River Health Strategy programs to the River Murray

River Murray Program	Actions	Contribution	RRHS Program
Vegetation Management	Restoration of riparian vegetation	Protects sources and transport of carbon (Program Goal 1)	A, C, D
		Protects habitat for species diversity and continuity of vegetation (Program Goal 2)	A, C, D
		Protects the intrinsic value of Riverina species diversity (Program Goal 3)	A, C, D
Channel Stability	Flow rehabilitation	Assists in managing flow related changes to the River Murray channel (Program Objective 1)	A, D
Community Engagement	Engaging and educating the community on river health issues	Promotes understanding of improved management in the River Murray (Program Goal 1)	F
Wetlands Management	Flow rehabilitation in the Broken Creek	Protects wetlands with significant environmental values (Program Objective 1)	A, D
	Improve river-floodplain linkages in the Lower Goulburn River	Increasing the number of wetlands with a more natural wetting and drying regime (Program Objective 2)	A
Water Quality	Water quality programs implemented	Mitigate existing adverse impacts of nutrient water quality on the River Murray (Program Goal 1)	A, C, D
	Restoration of riparian vegetation	Mitigate existing adverse impacts of turbidity water quality on the River Murray (Program Goal 1)	A, C, D
In-stream habitat improvement	Install fishways	Increase potential range of important endangered River Murray fish species (Murray cod, Macquarie perch)	A, D

17. Knowledge Gaps and Research

During the production of this Regional River Health Strategy, a number of information gaps were identified. These need to be investigated as a matter of urgency. Some actions within this Strategy may need to be revisited on the basis of successful filling of these knowledge gaps:

- In general, water quality data are scarce throughout the catchment, with many Management Units only having a single water quality measuring location. Alternative sources of data, such as Waterwatch, should be investigated to fill these gaps.
- Much of the information on fish composition and distribution is based on old records. Old records may have been collected at a time when environmental conditions were quite different from the current conditions. Changing environmental conditions may mean that some of these data are obsolete, and would need to be re-collected or confirmed. The monitoring Program for the Regional River Health Strategy [See Chapter 15] should go part of the way to resolving this.
- During the data checking process, it was discovered that the DSE Aquatic Fauna Database was out of date, with numerous known records of fish species missing from the dataset. DSE is urged to provide adequate resources to keep the database current, as aquatic fauna records are a vital component to the development of a Regional River Health Strategy.
- The Flow Deviation measure used in the ISC for this Regional River Health Strategy does not take into account the impact of farm dams. It is noted that the new ISC Flow Deviation measure (to be implemented) includes potential farm dam impacts.
- Records of water temperature deviations only include low temperature releases from low level outlets in large storages. Cleared river banks may lead to an increase in water temperature, and this needs to be accounted for in the data.
- In line with the Trout cod Recovery Plan, investigations will be conducted to ascertain the best sites in the catchment for stocking or translocation.
- A number of the ISC measures originally used turned out to be incorrect (usually due to a miscalculation of sub-indices). A program of validation of information sources needs to be conducted to ensure accurate data are available on which to base management decisions.
- Additionally, a number of ISC measures were missing from various reaches where they should have been measured. A quality control program should be implemented to ensure that all data are collected.
- A representative river for the North Central Floodplains River Region has not been identified in this Strategy. Following the 2004 ISC monitoring program, a suitable reach will be selected and actions developed to improve the condition of the reach to make it suitable for inclusion.

- The preservation of high valued rivers or reaches is generally considered a sound investment, and a key consideration in prioritisation of programs. A more detailed economic evaluation is considered necessary to assess the most effective targeting of programs.

- The lack of detailed economic analysis - return on investment and the benefits of protection and enhancement

In order to address knowledge gaps, identified above, knowledge and information program is to be established. Table 17.1 details a list of priority actions required together with indicative costs.

Table 17.1. Investigation and Planning Program

Knowledge Gap	Action / Activity	Indicative Cost ($'000) *(Priority)*
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.	50 (2)
ISC Data	• Conduct 5 yearly evaluations of stream condition and develop Catchment Report Card. • Increase spatial nature of assessments	included in MER development (1-2)
	• Review ISC assessment process, including validation of results and Data Storage	Underway (DSE) (1)
Water Temperature	• Investigate impacts of degraded riparian zones on water temperature	150 (2)
Assets and Values	• Commence assessment and collect available data on additional assets and threats associated with river health	25 (3)
Trout cod	• Investigate potential new locations for stocking or translocation of Trout cod, as outlined in the Trout cod Recovery Plan	20 (1)
Representative River	• Following the 2004 ISC evaluation, identify a reach suitable for Representative River for the North Central Floodplains River Region.	1 (3)
Economic Analysis	• Determine the economic value of healthy rivers within the Goulburn/Broken region (project underway by DSE)	Costed by DSE (1)

A mid-term review of this strategy will be undertaken in 2009 (See Chapter 20) where a detailed evaluation of knowledge gaps will be undertaken. This review will assess our progress towards addressing knowledge gaps and consider whether there is new science and knowledge that needs to be taken into account and incorporated into the strategy.

18. Implementing the Regional River Health Strategy

The successful implementation of the strategy will rely on effective management and leadership. There is a wide range of organisations within the catchment with responsibilities for river health. This catchment has benefited from many years of co-operative partnerships between the regions partners. We will take advantage of the existing networks and cooperative approaches and where necessary build on any identified limitations.

18.1 Partnerships in the Region

Goulburn Broken Catchment Management Authority (GBCMA) The CMA is responsible for the preparation of the RCS and reporting on progress towards its targets and outcomes. It is also responsible for works on waterways, regional drainage and floodplain management, and co-ordinates Commonwealth and State natural resource management investment in the region. Through its Implementation Committees, the GB CMA provides strong community ownership and input to the Strategy and its supporting sub-strategies.

Department of Sustainability and Environment (DSE) The DSE, through its responsibilities to the Minister under the Water Act and the Catchment and Land Protection (CALP) Act, provides financial, policy and strategic support for the development and implementation of the RCS and its sub-strategies. The department is also responsible for Statewide land use planning and the implementation of the Planning and Environment Act through DSE's responsibilities to the Minister for Planning..

Department of Primary Industries (DPI) DPI provides technical and extension support for developing and implementing the RCS. These services are provided through the Northern Irrigation and North East regional offices. Of particular importance is the research and development input provided by the department's research institutes.

Local government The Catchment includes the municipalities of Moira, Campaspe and the City of Greater Shepparton in the SIR and the Benalla Rural City and shires of Mitchell, Mansfield, Murrindindi and Strathbogie in the dryland part of the Catchment. Local governments are central to the Strategy's implementation through their responsibilities for land use planning, development approvals and management of stormwater.

Goulburn Murray Water (GMW) GMW provides irrigation, drainage, water supply and management of specific water supply catchments. It licenses surface and groundwater extractions, and plays a major role in irrigation salinity management, water quality management and regional economic development. It also contributes significantly to other riverine health outcomes.

Urban water authorities Goulburn Valley Water and North East Water provide water and wastewater services to urban communities in the region. These authorities manage specific water supply catchments and contribute to the water quality outcomes of the region by investment in improved wastewater management services.

Environment Protection Authority (EPA) The Environment Protection Authority has a responsibility to enable the protection of the uses and values of Victoria's environment by employing a range of measures consistent with its responsibilities under the Environment Protection Act 1970. EPA's primary role is to protect air, water and land from pollution, control industrial noise and minimise waste generation. EPA develops and administers a range of statutory tools to accomplish this, including the development of statutory policies. For example, the State environment protection

policy (Waters of Victoria), provides an agreed framework for government, businesses and communities to work in partnership to protect water environments.

Landholders Achieving the Strategy outcomes requires changes in the way we manage our natural assets. Under the Catchment and Land Protection Act Landholders are required to: 1) avoid causing or contributing to land degradation which causes or may cause damage to land of another owner; 2) conserve soil; 3) protect water resources; 4) eradicate regionally prohibited weeds; 5) prevent the growth and spread of regionally controlled weeds; and 6) prevent the spread of and, as far as possible, eradicate established pest animals. Landowner co-operation and participation is essential to achieve natural resource management (NRM) targets.

Waterwatch The Goulburn Broken Waterwatch program encourages community participation and understanding of water quality issues throughout the catchment. It encourages the engagement of regional agencies, local government, schools, and community groups in field and meeting based activities.

Landcare Landcare groups enable the community to participate directly in natural resource management, particularly by identifying and setting direction for on-ground works and mobilising community involvement in their local area. Landcare groups and networks will continue to play a major role in implementing the Regional Catchment Strategy.

Parks Victoria Approximately 94,421 ha of the Catchment is State and National parks managed by Parks Victoria. Its primary role is to ensure the conservation values of the parks and reserves network is protected.

Aboriginal Groups The Aboriginal community possess knowledge of their cultural history and the natural environment that is valuable in the development and implementation of natural resource management programs. Over the coming five years the CMA will build on existing arrangements to create an environment that promotes indigenous involvement, ownership and input.

Universities and TAFE Universities and TAFE Colleges operating in the region must continue to provide a high level of service and to produce graduates with an extensive knowledge of natural resource management issues. They have an ongoing role in providing support to natural resource managers through student and staff involvement in Catchment initiatives.

Trust for Nature Trust for Nature is a non-profit organisation which works to protect threatened ecosystems. The Trust focuses on its conservation covenant program and the purchase and re-selling of high conservation value land through its revolving fund. It helps community groups buy property, provides information and seeks to add value to regional research.

VicRoads VicRoads is responsible for maintaining and improving Victoria's 22,240 km of arterial roads, and 4,924 bridges and major culverts. VicRoads is actively involved in developing roadside management plans for its major roads. These plans will assist in managing roadside environments and include sections on pest plants and animals, retention of significant roadside areas, maintenance strategies and maintenance of firebreaks.

Industry Through its operating practices and peak industry groups, such as Murray Dairy and the Victorian Farmers Federation (VFF), industry is able to exert strong influence over natural resource management outcomes.

Environment groups These groups are major contributors to the outcomes of the RCS by either involvement in shaping the its direction or delivering onground works. The groups include the region's Environment Alliance Network, and the Goulburn Valley Environment Group.

18.2 Management Arrangements

The general roles of key management groups within the catchment are shown in Table 18.1. This is based on the Victorian River Health Strategy (NRE 2002).

Table 18.1 – Roles and Responsibilities for River Health

Regional	
Agency / Group	**Roles (General)**
Goulburn Broken Catchment Management Authority	• Caretaker of River Health • Establishment of the Environmental Water Reserve • Contribute to SFMP and Groundwater Management Plans • Develop, in partnership with the community and other stakeholders, the Regional River Health Strategy and other action plans which define the vision for the catchment and set targets for land and water management. • Provide advice to the State Government on both Federal and State resourcing priorities at a regional level. • Develop and implement measures for river protection and restoration to implement. • Encourage community involvement in river and catchment management. • Undertake floodplain management in accordance with the Victoria Flood Management Strategy. • Develop partnerships between resource managers in the catchment, and coordinate activities impacting on river health. • Provide a focus for regional investment in river and catchment management. • Monitor and report on the condition and management of the river and water resources in their region. • Provide community education. • Act as a communication conduit between regional communities and Government on issues relating to river and water management. • Prepare annual works and activity programs for the protection and enhancement of river systems.
Regional Resource Managers (DSE, DPI, GMW and urban Water Authorities)	• Participate (as partners) in the development and implementation of the regional RHS. • Undertake all activities which can potentially impact on rivers to best practice. • Recognise their dependence on a healthy resource base and their potential impact on it. • Develop and support partnerships with other resource managers in the catchment to enhance project coordination and implementation.
Local Government	• Work in partnership with CMAs to set priorities and implement the regional RHS. • Incorporate river restoration and catchment management objectives, priorities and actions into statutory planning processes. • Undertake floodplain management and flood warning in accordance with the Victoria Flood Management Strategy. • Develop and implement urban stormwater plans. • Manage rural drainage schemes where appropriate. • Facilitate local industry involvement in river restoration and catchment management activities • Provide local support for local action groups. • Undertake all activities which can potentially impact on rivers to best practice.
Industry	• Manage in accordance with the principles of ecologically sustainable development. • Minimise their impact on the environment by the implementation of best management practices.
Individuals and Groups	• Participate in regional planning, priority setting and the implementation of work programs related to river management and restoration. • Participate in community groups aimed at monitoring river health or undertaking restoration projects in priority areas. • Manage their own enterprises and actions in ways that acknowledge their ‘duty of care’ and their role in the stewardship of natural resources.

State and Federal	
Commonwealth Government	• Contribute funding to States, regional authorities, groups and individuals to achieve national objectives for river restoration and catchment management. • Facilitate national or interstate coordination where this is necessary. • Invest in the development of better management principles, tools and systems. • Improve the knowledge base through strategic research and development. • Provide incentives in areas of Commonwealth responsibility. • Ensure that the wider Australian community is well informed about natural resource management issues. • Facilitate the monitoring of the effectiveness of natural resource management at appropriate scales. • Oversee the implementation of relevant Commonwealth legislation including the En*vironment Protection and Biodiversity Conservation Act* 1999. • Ensure that Australia meets its obligations under international agreements. • Identify issues of national significance.
State Government	• Set Statewide policy and strategic directions for river restoration and for catchment and environmental protection. • Establish legislative frameworks. • Establish effective and efficient catchment/regional institutional arrangements. • Provide funding to achieve State and regional priorities. • Provide relevant advice, and undertake research and monitoring, planning, extension, on-ground works and some referral and enforcement functions to support regional communities. • Participate in effective intergovernmental processes and national approaches where necessary, and implement State responsibilities under nationally agreed strategies.

19. Economic Benefits and Cost Sharing

The Goulburn Broken Regional River Health Strategy has the following four key objectives.

- Protecting the rivers that are of highest community value from any decline in condition.
- Maintaining the condition of ecologically healthy rivers.
- Achieving an 'overall improvement' in the environmental condition of the remainder of rivers.
- Preventing damage from future management activities.

Generally the preservation of high valued rivers or reaches is a sound investment, not just because the works involved tend to be relatively cheap, but also because it can often be demonstrated that very high benefits are achieved when the correct basis of valuation is used (See Appendix 15).

While this River Health Strategy recommends that resources be directed to the areas of highest priority and to the most effective means of river restoration, it is clear that the task to be undertaken to achieve the vision is a major one requiring significant resources and long-term commitment by the State and Federal Governments and the local community.

19.1 Cost Sharing Principles

It is important that long term funding reflect the general cost-sharing principles for natural resource management (from NRE, 2002) and truly represent, in a fair and equitable way, the impacting groups and the various beneficiaries relating to river health.

The following cost sharing principles will be developed further and applied in the development and implementation of river protection and enhancement programs[40]:

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 which provide private benefits. Contributions from secondary beneficiaries will, where appropriate, be negotiated with the primary beneficiaries.

Government Contributions for Public Benefit

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 up-take.

[40] From the VRHS (NRE, 2002)

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.

Statewide Policy and Monitoring

Government will contribute to the cost of Statewide planning, Statewide resource monitoring and assessment, and research and investigations where they are crucial to sustainable land and water management.

20. Program Review (2010)

The Strategy contained within the document is dynamic, However the fundamentals of the issues to be addressed are unlikely to change or priority areas for action.. The Programs, Implementation Targets and Resource Condition Targets establish priority actions for the next ten years (2005-2015).

A mid-term review of this strategy will be undertaken in 2009 where a detailed evaluation of the progress towards the stated goals and objectives will be undertaken. 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.

Monitoring detailed within this Section is essential if we are going to have meaningful evaluation of this strategy. This will be achieved by monitoring each of the seven individual programs.

All relevant strategies and plans released in the interim will be included in future revisions of the River Health Strategy. In addition, the following information that was highlighted during the public comment period of this document will be investigated and included if appropriate:

- Updated targets (incorporating new or revised information)
- EPA data on macro-invertebrates and water quality and their application to SEPP (WoV) objectives.
- Identification of EPA programs that could address sub-catchment actions.
- Investigate the use of the EPA 'risk based assessment process' to set appropriate monitoring endpoints.
- Updated threatened/rare/endangered flora and fauna information.
- Incorporation of Rural Drainage, Channel Modification and Flooding information (threat values for each sub-catchment).
- Process to monitor and report on the progress of the actions towards the targets will be developed and implemented.
- Reference to specific indigenous assets in each sub-catchment (in consultation with Indigenous community members).
- Extending the Community Engagement component to incorporate costs/ targets in addressing Key Engagement Challenges will be identified.
- Reference and acknowledgement of current and past work by landholders to protect river health.
- Consider the inclusion of assets and threats such as;
    - Increasing urbanisation
    - Individual water quality parameters such as pesticides, chemicals, water temperature and nutrients.
    - Mining activities
    - Agricultural land use
    - Areas of Crown Land
    - Removal of large woody debris.

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22. Glossary of Terms

AROT: Australian Rare or Threatened Species

Aquatic: relating to water. Formerly used for inland waters but may be used for marine and estuarine waters as well.

Bankfull width: where the river channel is filled from the top of one bank to the other.

Benthic: bottom dwelling. Usually refers to organisms living on the substratum. This assemblage is collectively know as benthos.

Biota: all organisms of an ecosystem (usually the fauna and flora).

Biomass: the total mass of living material occupying a specific part or the whole of an ecosystem at a given time. Usually expressed as live or dry weight per unit area.

Degraded: the lowering of a streambed with time due to erosion and transport of bed materials, or the blockage of sediment sources.

Detritus: organic debris from decomposing organisms and their products. A major source of nutrients and energy for some aquatic food webs.

Ecologically Health Waterway: a river which retains the major ecological features and functioning of that river prior to European settlement and which would be able to sustain these characteristics into the future

Ecosystem: the combination of a community (biota) and its abiotic environment. Ecosystems are characterised by ecological processes such as the flow of energy and nutrients through food webs.

Ecotone: region lying between two ecosystems, often sharing some ecological features of both. The riparian zone represents an ecotone between a river or stream and its catchment.

Ephemeral: containing water only after unpredictable rain.

Erosion: the process by which the surface of the earth is worn away by the action of water, glaciers, wind and waves.

Eutrophication: an increase in the nutrient status of a body of water. Occurs naturally with increasing age of a waterbody, but much more rapidly as a by-product of human activity.

Floodplain: the land adjacent to a channel at the elevation of the bankfull discharge.

Geomorphology: the science that studies the evolution of the earths surface. The systematic examination of landforms and their interpretation of geologic history.

Groundwater: water occurring below the ground's surface.

Indigenous: a plant native to an area; has not been introduced from elsewhere.

Index of Stream Condition: The Index of Stream Condition (ISC) methodology was developed to benchmark the condition of streams (a snapshop of the catchment), assess the effectiveness of programs and to assist with priority setting. The Index is a measure of a stream's change from natural or ideal conditions. It presents an indication of the extent of change in respect of five key "stream health" indices: Hydrology (change in volume and seasonal flow); Physical Form (stability, degradation/aggradation, influence of artificial barriers and abundance/absence of instream debris); Streamside Zone (Plant species – native / exotic, spatial extent, width, continuity and links); Water Quality (assessment of total phosphorus, Turbidity, conductivity and pH); and Aquatic Life (abundance and type of macro invertebrates).

Large woody debris: Branches and tree boles that have fallen into the watercourse. Often referred to as snags.

Macroinvertebrates: larger invertebrates, and large enough to be observed without the aid of a microscope. Their body length usually exceeds 1mm.

Management Action/Implementation Targets: Short term targets (1-5 years), relating to management actions or capacity-building.

Noxious: an official designation for a plant that is a serious weed and must be controlled.

Overgrazed: land that has been grazed by livestock to the extent that erosion and soil degradation is occurring.

Overland flow: downslope, surface movement of runoff other than in defined channels, usually with high erosion potential.

Pugging: livestock trampling soil and water together, to create muddy depressions at the edge of rivers and other waterbodies.

Ramsar: Australia is a signatory to the Convention on Wetlands (Ramsar, Iran, 1971) the broad aims of which are to halt, and where possible reverse, the worldwide loss of wetlands and to conserve those that remain through wise use and management. The convention is commonly known as the Ramsar Convention after the Iranian town in which it was first signed in 1971.

Resource Condition Target: Specific, timebound and measurable targets, relating largely to the, desired condition of natural resources in the longer term.

Riffle: an area of river which is wide and shallow, the water flowing over a pebble bed with protruding rocks. A stream section with fast and turbulent flow, rapids.

RiVERS Database: RiVERS is a database that integrates environmental, social and economic information from a variety of sources into a single package. RiVERS relies on existing datasets, including the Index of Stream Condition, statewide flora and fauna databases, EPA water quality datasets and data collated by the CMAs.

Rare: A species that characteristically has a limited distribution and or abundance due to the specificity of their habitat requirements or that has a limited distribution and abundance because habitat resources have been modified or lost.

Riparian: vegetation found along the bank of streams and rivers.

Riparian zone: any land which adjoins, directly influences, or is influenced by a body of water.

Threatened: A generic term used to describe taxa that are rare, vulnerable, endangered or insufficiently known and are subject to a threatening process

Vulnerable: Species likely to become endangered in the short term should a threatening process continue.

Water-dependant: aquatic species or those dependant on river water for survival.

Weed: any useless, troublesome or noxious plant, especially one that grows profusely.