

2009-2010

# Goulburn Broken Catchment

## Final Dry Inflow Contingency Plan

The Dry Inflow Contingency Plan provides the basis and direction for the management of priority river, floodplain and wetland values in the Goulburn Broken Catchment if lower than average flows are experienced again in the 2009-2010 season



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It should be noted that specific reference to funding levels in this strategy are for indicative purposes only. The level of Government investment in this plan is contingent on budgets and government priorities.

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**Cover:** Signet at Black Swamp (Paul O'Connor), Water-shield at Tahbilk Lagoon (Keith Ward) and Brolga at Kinnairds Wetland (Paul O'Connor).

# Document History

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## History

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# Executive Summary

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The Goulburn Broken Catchment has experienced below average rainfall since 1997 and recent inflows to its rivers have been some of the lowest on record. This has put the Catchment's rivers and associated wetlands, floodplains, flora and fauna under significant stress and continued dry condition in 2009-2010 may result in their loss or reduced functioning.

The Dry Inflow Contingency Plan (Plan) provides the basis and direction for the management of priority river, floodplain and wetland values in the Goulburn Broken Catchment if lower than average flows are experienced again in the 2009-2010 season. As the caretaker of river health and the manager of the environmental water reserve, the Goulburn Broken Catchment Management Authority has the key responsibility of delivering, implementing and monitoring the Plan. However, its success is reliant upon the strong support and resources of partner agencies, the community and the State.

The Plan assesses the likely operation and environmental condition of the streams and wetlands that support or provide refuge for priority values under four low inflow scenarios (a repeat of 2006-2007, 99% probability of exceedence inflow, 95% probability of exceedence inflow and 90% probability of exceedence inflow). The priority river, floodplain and wetland values in the Goulburn Broken Catchment considered to be at most serious threat from the impacts of low or no inflows in 2008-2009 (habitat loss and reduced water quality) are fish, waterbirds, amphibians and aquatic dependent macroinvertebrates, reptiles and flora species:

- listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999;
- listed under the Victorian Flora and Fauna Guarantee Act 1988;
- listed as critically endangered, endangered or vulnerable by the Department of Sustainability and Environment; and
- at risk of local extinction due to their small or isolated population.

In addition, ecologically healthy river reaches identified in the Goulburn Broken Regional River Health Strategy are considered important ecological values that require protection from the impacts of no or low inflows in 2009-2010.

A total of 46 actions are identified costing approximately \$815,000. The actions aim to:

- avoid local extinction of priority species and communities;
- maintain a geographic distribution of priority species and communities to facilitate their recovery;
- avoid catastrophic events such as fish deaths;
- maintain the values and functions of Ecologically Healthy Rivers;
- avoid loss of priority areas where significant past ecological investment has occurred;
- minimise impacts on human health; and
- maintain the ecological values and functions of priority streams and wetlands.

The actions include:

- Regulating flows to maintain or improve aquatic habitat.
- Enforcing or amending existing rules for water extraction to maintain or improve aquatic habitat.
- Monitoring water quality and native fish populations.
- Translocating native fish populations.
- Fencing out or removing stock from riparian and wetland habitats to reduce grazing pressure on native vegetation, maintain fauna habitat and reduce nutrient and sediment inputs.
- Controlling pest plants to reduce competition with native flora species and maintain or improve fauna habitat.
- Protecting and increasing drought refuge.

Of these actions 35 are of high priority and cost \$455,000. These actions aim to provide habitat for priority values and protect them from local extinction. The priority values include waterbirds (e.g. Brolga, Great Egret, Little Egret, Intermediate Egret, Whiskered Tern and Gull-bill Tern) and fish (e.g. Barred Galaxias, Macquarie Perch, Murray Cod, Trout Cod, Dwarf Flat-headed Gudgeon, Southern Pygmy Perch and Silver Perch).

The ongoing development and implementation of this Plan will be undertaken in consultation with key stakeholders and coordinated with a number of relevant programs including fire rehabilitation planning for the Kilmore East – Murrindindi Complex North Fire. In addition, the Plan is a live document that will evolve as new information becomes available and as the inflows, losses and demands of river systems change.

# Contents

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Executive Summary .....	iv
Glossary .....	vi
Key to Tables .....	vii
1 Introduction .....	1
1.1 Background .....	1
1.2 Purpose .....	1
1.3 Management Objectives .....	1
1.4 Information Sources.....	1
1.5 Limitations .....	1
1.6 Consultation .....	3
1.7 2008-2009 Dry Inflow Contingency Plan .....	3
2 Ecological Values.....	4
2.1 Flora, Fauna and Ecologically Healthy Rivers .....	4
2.2 Priority Ecological Values .....	4
2.3 Streams and Wetlands .....	4
2.3.1 Regulated Streams .....	4
2.3.2 Unregulated Streams .....	5
2.3.3 Wetlands.....	6
3 In-flow Scenarios .....	7
3.1 Regulated Streams .....	7
3.1.1 Broken and Boosey Creeks upstream of Katamatite Township .....	7
3.1.2 Broken and Nine Mile Creeks downstream of Katamatite .....	9
3.1.3 Broken River .....	11
3.1.4 Goulburn River (Lake Eildon to the Murray River) .....	12
3.2 Unregulated Streams.....	16
3.3 Wetlands .....	18
3.3.1 Operation.....	18
3.3.2 Environmental Conditions .....	18
4 Risk Management Priorities .....	20
4.1 Regulated Streams .....	21
4.2 Unregulated Streams.....	22
4.3 Wetlands .....	23
4.3 Waterbirds .....	24
5 Management Actions .....	26
5.1 Actions for Regulated Streams .....	26
5.2 Actions for Unregulated Streams .....	30
5.3 Actions for Wetlands and Waterbirds .....	31
5.4 Complimentary Actions.....	32
5.5 Action Summary .....	33
6 Links .....	35
7 Communication & Engagement .....	37
8 References .....	39
Appendix 1- Priority Ecological Values.....	40
Appendix 2- Environmental Water Provisions .....	51
Appendix 3 - Impacts of low or no inflow into streams.....	54
Figure 1 Goulburn Broken Catchment .....	2
Figure 2 Regulated streams and their reach numbers .....	55
Figure 3 Unregulated streams and their reach numbers .....	56
Figure 4a Priority Wetlands .....	57
Figure 4b Priority Wetlands .....	58
Figure 5 Area burnt in the Goulburn Broken Catchment by the Kilmore East – Murrindindi Complex North Fire .....	59

# Glossary

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**bank:** usually the steep part of the river channel above the usual water level, but it can also include the same section below the water level.

**bank full:** carrying capacity of the stream before spilling out onto adjacent land.

**bed:** that part of the river channel that is usually or normally covered with water when the river is flowing, also can refer to the bottom of the watercourse.

**channel:** that part of a river where water flows at some time and includes the bed and banks, taken to mean the whole of the depression in which the water flows before it rises sufficiently to spill over onto adjacent lands as flood water.

**channel width:** distance across the water surface from bank to bank at summer flows and measured in metres.

**confluence:** where two streams meet.

**degraded:** the waterbody has been altered resulting in loss of quantity or quality of habitat available for biota.

**environmental flow:** flow that maintains biota within the channel and allows all normal ecological processes and ecological activities to continue.

**Environmental Protection and Biodiversity Conservation Act 1999:** under the Act, actions that are likely to have a significant impact on matters of national environmental significance are subject to a rigorous assessment and approval process. The Act also promotes the conservation of biodiversity by providing strong protection for threatened species and ecological communities, migratory, marine and other protected species. The Act provides for: identification of key threatening processes; protection of critical habitat; preparation of management plans; and issuing of conservation orders and regulation of wildlife import/export.

**fishway:** a construction or modification to a barrier which enables fish to pass either upstream and/or downstream.

**Flora and Fauna Guarantee Act 1988:** establishes a legal and administrative structure to enable and promote the conservation of Victoria's native flora and fauna and provides a choice of procedures which can be used for the conservation, management, or control of flora and fauna and the management of potentially threatening processes.

**flow:** movement downstream of water confined in the channel. The term **lotic** applies to flowing or moving water.

**flow regime:** pattern of seasonal flow variations in any one year, usually consisting of periods of low flow during summer-autumn then high flows during winter-spring.

**freshes:** flows that produce a substantial rise in river height for a short period, but do not overtop the river bank. Freshes help maintain water quality and serve as life-cycle cues for fish.

**habitat:** specific location where a fish carries out a particular biological activity such as spawning, feeding or resting. Such areas can be referred to as spawning habitat, feeding habitat and resting habitat.

**high flows:** high flow within channel capacity. High flows allow full connection between all habitats in the river, which is important to fish passage during migration.

**instream:** refers to that area of a waterway below the surface of the water.

**macroinvertebrates:** animals without backbones, generally visible with the naked eye and associated with freshwater systems.

**pool:** a significantly deeper area in a river.

**Ramsar:** also known as the Ramsar Convention (first convened in Ramsar Iran 1971). It is an intergovernmental treaty with now (December 2000) 123 contracting parties with 1044 wetland sites designated for inclusion in the list of wetlands of international importance. There are currently 56 Ramsar sites in Australia.

**reach:** a visible length of river extending away from or adjacent to the observer, also a length of river with various water types such as pools and riffles.

**representative rivers:** rivers that were identified by the Land Conservation Council in 1990 as being representative of 16 different river-catchment types. They are in a relatively natural condition with significant geomorphic characteristics.

**riparian vegetation:** vegetation growing on the water line, up the bank or along the very top of the bank. It is the vegetation which has the most direct affect on instream biota.

**riparian zone or riparian area:** is the interface between land and a stream. The word "riparian" is derived from Latin ripa, meaning river bank.

**self-sustaining:** populations of fish which through natural spawning can maintain their numbers, has the same meaning as natural recruitment.

**translocate:** moving wild fish from one water into another.

**turbid water:** turbidity is an indication of the visual aspect of water and is influenced by suspended particulate matter, both inorganic and organic detritus, colloidal matter and biogenic particulate matter such as algae contribute to the turbidity of surface waters. Turbidity is measured in NTU units by the extent to which the particles in suspension scatter light.

# Key to Tables

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## Section 5: Management Actions

7GL	Funds received from the sale of 7GL of environmental water
ARI	Arthur Rylah Institute
DEP	Drought Employment Program
DHS	Department of Human Services
DPI	Department of Primary Industries
DSE	Department of Sustainability and Environment
ERA	Environmental Risk Assessment
EWR	Environmental Water Reserve
GB CMA	Goulburn Broken Catchment Management Authority
G-MW	Goulburn-Murray Water
GVW	Goulburn Valley Water
MDBC	Murray Darling Basin Commission
PV	Parks Victoria
RCIP	Regional Catchment Investment Plan
RHWQ	River Health and Water Quality Program
TBD	To be determined
VEFMAP	Victorian Environmental Flow Monitoring
VWT	Victorian Water Trust
WONS	Weeds of National Significance
TBD	To be determined

## Appendix 1: Priority Ecological Values

### Habitat description:

AMPH	Amphibious (both in and out of water)
OA	Obligate Aquatic (totally aquatic)
OLAC	Obligate Lacustrine
RAMPH	Riparian Amphibious
RIV	River
RO	Riparian Obligate
ROA	Riparian Obligate Aquatic
RWAMPH	Riparian Wetland Amphibious
RWOA	Riparian Wetland Obligate Aquatic
WAMPH	Wetland Amphibious
WET	Wetland

### Conservation Status in Australia (EPBC):

CR	Critically Endangered
EN	Endangered
VU	Vulnerable

### Flora and Fauna Guarantee Act 1988 Status (FFG):

L	Listed
N	Nominated for listing as threatened

### Conservation Status in Victoria (DSE):

CR	Critically Endangered
DD	Data Deficient
EN	Endangered
VU	Vulnerable

# 1 Introduction

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## 1.1 Background

The Goulburn Broken Catchment (Figure 1) has experienced below average rainfall since 1997 and recent inflows to its rivers have been some of the lowest on record. This has put the Catchment's rivers and associated wetlands, floodplains, flora and fauna under significant stress and continued dry condition in 2009-2010 may result in their loss or reduced functioning. As the caretaker of river health and the manager of the environmental water reserve, the Goulburn Broken Catchment Management Authority is committed to eliminating or minimising these potential impacts where practical through the delivery, implementation and monitoring of this Dry Inflow Contingency Plan with the support and resources of partner agencies and the State.

## 1.2 Purpose

The Dry Inflow Contingency Plan (Plan) provides the basis and direction for the management of the Catchment's significant rivers and associated wetlands, floodplains, flora and fauna if lower than average flows are experienced again in the 2009-2010 season.

The Plan:

- identifies management objectives for the protection of the Catchment's significant rivers and associated wetlands, floodplains, flora and fauna;
- identifies ecological values which are seriously threatened by no or low inflows in 2009-2010;
- prioritises these ecological values by assigning scores to their threatened status;
- identifies streams and wetlands which support or provide refuge for these values;
- describes the current operation and ecological condition of the streams and wetlands;
- describes the operation and ecological condition of the streams and wetlands under four 2009-2010 in-flow scenarios;
- determines high, medium and low risk management priorities according to the likelihood and consequence of the major threat types (habitat loss and reduced water quality) impacting on the ecological values;
- identifies actions that address the management objectives and the risk management priorities;
- identifies links with complementary emergency management and drought response plans and programs; and
- outlines how key stakeholders and the wider community will be informed and involved during the development and implementation of the Plan.

This Plan is a live document that will evolve as new information becomes available and as the inflows, losses and demands of river systems change.

## 1.3 Management Objectives

The Plan aims to achieve the following seven management objectives:

- i. avoid local extinction of priority species and communities;
- ii. maintain a geographic distribution of priority species and communities to facilitate their recovery;
- iii. avoid catastrophic events such as fish deaths;
- iv. maintain the values and functions of Ecologically Healthy Rivers;
- v. avoid loss of priority areas where significant past ecological investment has occurred;
- vi. minimise impacts on human health; and
- vii. maintain the ecological values and functions of priority streams and wetlands.

## 1.4 Information Sources

The Flora Information System of Victoria and the Wildlife Atlas of Victoria data sets (DSE 2005) were analysed to help identify the priority values in the Goulburn Broken Catchment, which will be seriously threatened by no or low inflows in 2009/010. In addition, information was collated from relevant research documents, state-wide digital mapping layers, management plans and reports including the Goulburn Broken Regional River Health Strategy (GB CMA 2005). The inflows, losses and demands of river systems under the three flow scenarios were derived from REALM models developed by the Department of Sustainability and Environment and predictions made by relevant water authorities. This information was supplemented by discussions with people with an intimate knowledge of the study area, its ecological values and the management and operation of its river and wetland systems.

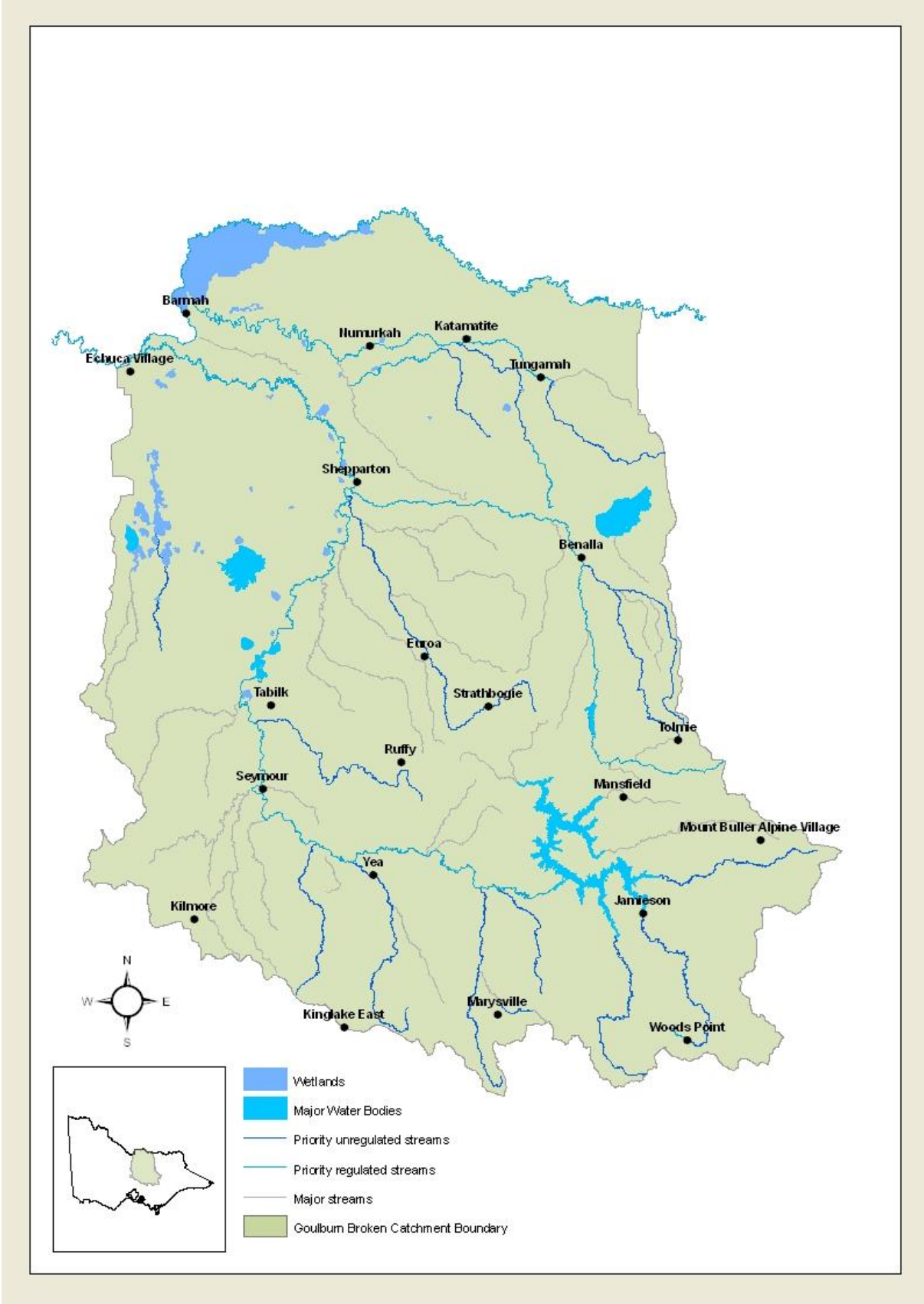
## 1.5 Limitations

The information sources used in the development of this plan have a number of limitations including:

- The lack of knowledge about the distribution and characteristics of invertebrate and non-vascular plant species means that assessments are weighted towards the less cryptic elements of flora and fauna, i.e. vascular flora and vertebrate fauna.



Figure 1 Goulburn Broken Catchment.



- The data contained in the Flora Information System and the Atlas of Victorian Wildlife comes from a combination of incidental records and systematic surveys. The data varies in accuracy and reliability due to the distribution and intensity of survey efforts.
- This plan draws on material collated from management plans, research documents and published literature. These sources vary in their age and hence the degree to which they reflect the current situation.
- REALM models utilise inflow, climate, demand and losses data which varies in accuracy and reliability.

The development of the Plan only considers:

- all regulated rivers;
- priority unregulated rivers identified in the Goulburn Broken Regional River Health Strategy (GB CMA 2005);
- unregulated rivers that support priority ecological values;
- wetlands of international and national significance; and
- wetlands identified for inclusion on the Victorian Water Register.

The development of the Plan does not consider:

- riparian and wetland vegetation communities due to their capacity to regenerate when favorable conditions are restored; and
- the significant impact the prolonged dry conditions are potentially having on the habitat, abundance and reproduction of terrestrial flora and fauna.

## 1.6 Consultation

This Plan was prepared by the Goulburn Broken Catchment Management Authority and comment on its structure and content was sought from key partners including the Environmental Water and River Health Unit of the Department of Sustainability and Environment, Goulburn-Murray Water, North East Regional Water Authority and Goulburn Valley Regional Water Authority. This consultation process has enabled the authority to identify key assets at risk from low or no flow and enabled meaningful discussion with managers of water on options available for their protection.

## 1.7 2008-2009 Dry Inflow Contingency Plan

The 2008-2009 Goulburn Broken Catchment Dry Inflow Contingency Plan was completed in October 2008. A review of the Plan was undertaken in January 2008. The review indicated that of the 74 actions identified in the Plan, 86% were completed or partially completed, 11% did not commence and 3% were not required to be undertaken due to the scenario conditions not been met. Of the high priority actions 86% were completed or were partially completed, 7% did not commence and 7% were not required to be undertaken due to the scenario conditions not been met.

For consistency the 2009-2010 Plan has been developed in accordance with the 2007-2008 and 2008-2009 Plans and informed by their development, implementation and review. However, the following revisions have been made to the 2009-2010 Plan:

- The Plan identifies waterbirds as an ecological value that is under serious threat in 2009-2010. The previous plans did not consider waterbirds to be under serious threat due to their mobility and capacity to utilize alternative aquatic environments. However, waterbird abundance, breeding and habitat have significantly declined across Victoria and much of the Murray-Darling Basin in response to the prolonged dry conditions (Birds Australia 2008; Porter et al. 2006).
- The 2008-2009 Plan assessed over 140 priority wetlands. Environmental water can not be delivered to the vast majority of these wetlands to increase or improve aquatic habitat. Therefore, this Plan only considers 46 wetlands that have been identified for inclusion on the Victorian Water Register. These wetlands have been chosen due to their conservation status, ecological values and their current and potential ability to receive environmental water. In the near future only wetlands listed on the Register will be eligible to receive an environmental water allocation.

## 2 Ecological Values

This section outlines the ecological values in the Goulburn Broken Catchment considered at most serious threat from no or low inflows in 2009-010, prioritises them by assigning scores to their threatened status and identifies the streams and wetlands that support or provide refuge for them.

### 2.1 Flora, Fauna and Ecologically Healthy Rivers

The ecological values in the Goulburn Broken Catchment considered at most serious threat from no or low inflows in 2009-20010 are fish, waterbirds, amphibians, and aquatic dependent macroinvertebrates, reptiles and flora species:

- listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999;
- listed under the Victorian Flora and Fauna Guarantee Act 1988;
- listed as critically endangered, endangered or vulnerable by the Department of Sustainability and Environment; and
- at risk of local extinction due to their small or isolated population (Appendix 1).

Ecologically healthy rivers identified in the Goulburn Broken Regional River Health Strategy are also considered important ecological values that require protection from the impacts of no or low inflows in 2009-20010. Ecologically healthy rivers are described by the Victorian River Health Strategy as 'a river that 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 Goulburn Broken Regional River Health Strategy identifies the following five reaches as ecologically healthy rivers: Taggerty River (Reach 64); Goulburn River (Reach 15); Big River (Reach 68) and Ryans Creek (Reach 17).

### 2.2 Priority Ecological Values

To help establish management priorities, the flora and fauna values in the Goulburn Broken Catchment considered at most serious threat from no or low inflows in 2009-20010 have been prioritised. High, medium and low priorities have been determined by assigning scores to threatened status attributes of the flora and fauna values according to set criteria (Appendix 1). In addition, a high priority ranking has been given to:

- ecologically healthy rivers due to their conservation significance; and
- the Dwarf Flat-headed Gudgeon, Southern Pygmy Perch and Brolga, which are at risk of local extinction due to their small, isolated populations and dependence on wetland habitats.

This process for assigning priority rankings is incapable of absolute precision as it relies upon the accuracy of flora and fauna data sets and the subjective assessments of staff. However, the process is not intended to precisely determine ranking order. Instead it is intended to provide useful indicative rankings which can be modified as information and circumstances change. Table 1 lists the flora and fauna values in the Goulburn Broken Catchment considered at most serious threat from no or low inflows in 2009-20010 with a high priority ranking. Table 31 in Appendix 1 lists all the flora and fauna values in the Goulburn Broken Catchment considered at most serious threat from no or low inflows in 2009-20010 and their ranking

Table 1 Flora and fauna values at most serious threat from no or low inflows and their priority ranking.

Common Name	Scientific Name	Priority
Barred Galaxias	<i>Galaxias fuscus</i>	High
Dwarf Flat-headed Gudgeon	<i>Phlypnodon macrostomus</i>	High
Painted Snipe	<i>Rostratula benghalensis</i>	High
Brolga	<i>Grus rubicunda</i>	High
Southern Pygmy Perch	<i>Nannoperca australis</i>	High
Spotted Tree Frog	<i>Litoria spenceri</i>	High
Trout Cod	<i>Maccullochella macquariensis</i>	High
Macquarie Perch	<i>Macquara australasica</i>	High

### 2.3 Streams and Wetlands

In the Goulburn Broken Catchment a total of 5 regulated streams, 16 unregulated streams and 33 wetlands have been identified that support or provide refuge for priority ecological values at risk from no or low inflows.

#### 2.3.1 Regulated Streams

The Boosey Creek, Broken Creek, Broken River, Goulburn River below Lake Eildon and the Nine Mile Creek support or provide refuge for 45 priority values at risk from no or low inflows (Figure 2). Of these priority values seven are listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and 30 are listed under the Victorian Flora and Fauna Guarantee Act 1988. Table 2 lists the regulated streams that support or provide

refuge to high priority values. Appendix 1 lists all the priority values and the regulated streams that support or provide refuge for them.

Table 2 Regulated streams that support or provide refuge for high priority ecological values.

Stream	Reach	Ecological Value		Priority
		Common Name	Scientific Name	
Broken Creek		Brolga	<i>Grus rubicunda</i>	High
Broken River	3 - 5	Macquarie Perch	<i>Macquara australasica</i>	High
	1-4	Trout Cod	<i>Maccullochella macquariensis</i>	High
Goulburn River below Lake Eildon	9	Brolga	<i>Grus rubicunda</i>	High
	14	Painted Snipe	<i>Rostratula benghalensis</i>	High
	29	Brolga	<i>Grus rubicunda</i>	High
	14	Painted Snipe	<i>Rostratula benghalensis</i>	High
Nine Mile Creek	29	Brolga	<i>Grus rubicunda</i>	High

In addition, the Broken Creek, Broken River and the Goulburn River have other complementary environmental, social and economic values. The Broken Creek, the Broken River downstream of Benalla (reaches 1 – 2) and the Goulburn River downstream of the Goulburn Weir (reaches 1 – 8) are wetlands of national significance listed in 'A Directory of Important Wetlands in Australia'. The Goulburn River downstream of Lake Eildon to the confluence with the Murray River (reaches 1- 14) has been identified as a heritage river corridor by the Land Conservation Council (LCC 1991). The Goulburn Broken Regional River Health Strategy classified reaches 5, 6, 8 and 9 of the Goulburn River as having very high overall social significance and reach 14 as having very high overall economic significance.

### 2.3.2 Unregulated Streams

Of the 19 priority unregulated streams identified in the Goulburn Broken Regional River Health Strategy 14 support or provide refuge for 19 priority values at risk from no or low inflows, including ecologically healthy river reaches (Figure 3). Of these priority values six are listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and 13 are listed under the Victorian Flora and Fauna Guarantee Act 1988. In addition, the unregulated Leary's (a tributary of Steavenson River) and Sunday Creeks support Barred Galaxias (Figure 3). This fish is listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and the Victorian Flora and Fauna Guarantee Act 1988. Due to the lack of suitable habitat and the impact of the recent Kilmore East – Murrindindi Complex North Fire on stream water quality and habitat, a number of threatened fish species have been removed from priority regulated streams (see section 3.2). Table 3 lists the unregulated streams that support or provide refuge for high priority values. Appendix 1 lists all the priority values and the unregulated streams that support or provide refuge for them.

Table 3 Unregulated streams that support or provide refuge for priority ecological values.

Stream	Reach	Ecological Value		Priority
		Common Name	Scientific Name	
Big River	68	Ecologically healthy river		High
	67	Spotted Tree Frog	<i>Litoria spenceri</i>	High
Goulburn River above Lake Eildon	16	Barred Galaxias	<i>Galaxias fuscus</i>	High
	15	Ecologically Healthy River		High
	15	Macquarie Perch	<i>Macquara australasica</i>	High
	16	Spotted Tree Frog	<i>Litoria spenceri</i>	High
Holland Creek	13-14	Macquarie Perch	<i>Macquara australasica</i>	High
Howqua River	70	Spotted Tree Frog	<i>Litoria spenceri</i>	High
Hughes Creek	37	Macquarie Perch	<i>Macquara australasica</i>	High
King Parrot Creek	51	Macquarie Perch	<i>Macquara australasica</i>	High
Leary's Creek	NA	Barred Galaxias	<i>Galaxias fuscus</i>	High
Rubicon River	66	Barred Galaxias	<i>Galaxias fuscus</i>	High
Ryans Creek	17	Ecologically healthy river		High
Seven Creeks	19-20	Macquarie Perch	<i>Macquara australasica</i>	High
	19	Trout Cod	<i>Maccullochella macquariensis</i>	High
Sunday Creek	NA	Barred Galaxias	<i>Galaxias fuscus</i>	High
Taggerty River	64	Barred Galaxias	<i>Galaxias fuscus</i>	High
	64	Ecologically healthy river		High
Steavenson River	NA	Barred Galaxias	<i>Galaxias fuscus</i>	High
Yea River	55	Macquarie Perch	<i>Macquara australasica</i>	High

In addition, the Big River, Delatite River, Howqua River, Ryans Creek and Taggerty River have other complementary environmental, social and economic values. The Big and Howqua Rivers are wetlands of national significance listed in 'A Directory of Important Wetlands in Australia'. The Big River and the Howqua River (reach 69) have been identified

as heritage river corridors by the Land Conservation Council (LCC 1991). The Big River, Ryans Creek and Taggerty River have been selected by the Goulburn Broken Regional River Health Strategy as representative rivers. Representative rivers are reaches in ecologically healthy condition that can be seen to represent major river classes or types that occur in Victoria. The Goulburn Broken Regional River Health Strategy classified the Delatite (reach 72) and Howqua (reach 69) Rivers as having very high overall economic significance.

### 2.3.3 Wetlands

In the Goulburn Broken Catchment a number of wetlands of conservation significance have been formally recognised. These include one wetland of international significance (or Ramsar site) listed under the Convention on Wetlands (Ramsar, Iran, 1971) and 10 wetlands of national significance listed in A Directory of Important Wetlands in Australia. Of the 10 wetlands of national significance, five are streams and are included in the regulated and unregulated stream sections above. In addition, 46 wetlands have been identified for inclusion on the Victorian Water Register. These wetlands have been chosen due to their ecological values and their current and potential ability to receive environmental water. In the near future only wetlands listed on the Register will be eligible to receive an environmental water allocation.

A total of 33 wetlands support or provide refuge to 52 priority values at risk from no or low inflows (Figures 4a and 4b). Of these priority values eight are listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and 29 are listed under the Victorian Flora and Fauna Guarantee Act 1988. Table 4 lists these priority values, their conservation status and the wetlands in which they were recorded. Appendix 1 lists all the priority values and the wetlands that support or provide refuge for them.

Table 4 Wetlands that support or provide refuge for priority ecological values.

Wetland	Status	Ecological Value		Priority
		Common Name	Scientific Name	
Barmah Forest	Ramsar Site, VWR	Brolga	<i>Grus rubicunda</i>	High
		Dwarf Flat-headed Gudgeon <sup>1</sup>	<i>Philypnodon macrostomus</i>	High
		Macquarie Perch	<i>Macquara australasica</i>	High
		Southern Pygmy Perch <sup>1</sup>	<i>Nannoperca australis</i>	High
		Trout Cod	<i>Maccullochella macquariensis</i>	High
Brays Swamp	VWR	Brolga	<i>Grus rubicunda</i>	High
Broken Creek Wetland <sup>B</sup>	WONS, VWR	Brolga	<i>Grus rubicunda</i>	High
Doctors Swamp	VWR	Brolga	<i>Grus rubicunda</i>	High
Gaynor Swamp <sup>W</sup>	WONS, VWR	Brolga	<i>Grus rubicunda</i>	High
Greens Lake	VWR	Brolga	<i>Grus rubicunda</i>	High
Greens Swamp	VWR	Brolga	<i>Grus rubicunda</i>	High
Kanyapella Basin	WONS, VWR	Brolga	<i>Grus rubicunda</i>	High
		Painted Snipe	<i>Rostratula benghalensis</i>	High
Kinnairds Swamp	VWR	Brolga	<i>Grus rubicunda</i>	High
Lake Stewart	VWR	Brolga	<i>Grus rubicunda</i>	High
Mansfield Swamp <sup>W</sup>	WONS, VWR	Brolga	<i>Grus rubicunda</i>	High
Moodies Swamp <sup>B</sup>	WONS, VWR	Brolga	<i>Grus rubicunda</i>	High
Muckatah Depression	WONS	Brolga	<i>Grus rubicunda</i>	High
Murray Road Wetland	VWR	Brolga	<i>Grus rubicunda</i>	High
One Tree Swamp <sup>W</sup>	WONS, VWR	Brolga	<i>Grus rubicunda</i>	High
Stockyard Plain	VWR	Brolga	<i>Grus rubicunda</i>	High
Two Tree Swamp <sup>W</sup>	WONS, VWR	Brolga	<i>Grus rubicunda</i>	High
Wallenjoie Wetlands <sup>W</sup>	WONS, VWR	Brolga	<i>Grus rubicunda</i>	High
Woolwash Swamp	VWR	Brolga	<i>Grus rubicunda</i>	High

<sup>1</sup> Small populations vulnerable to local extinction (Ward, pers. comm. 2007).

<sup>B</sup> These wetlands are part of the Broken Creek floodplain listed on the Directory of Important Wetlands in Australia.

<sup>W</sup> These wetlands are part of the Wallenjoie wetland complex listed on the Directory of Important Wetlands in Australia.

Ramsar Listed under the International Convention on Wetlands (Ramsar, Iran, 1971).

WONS Wetland of national significance listed in a Directory of Important Wetlands in Australia.

WOBS Wetland of bioregional significance identified for the National Land and Water Resources Audit.

## 3.0 In-flow Scenarios

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With the dry conditions in 2008-2009, on top of a period of drier than average conditions, it is expected that water storages will be empty (or near to) by the end of 2008-2009. This means that in 2009-2010, the availability of water is dependent on inflows, minimising losses, and utilising water not normally part of the active storage.

This section describes the:

operation and environmental condition of the streams and wetlands during 2008-2009 season that support or provide refuge for priority values;

The likely operation and environmental condition of the streams and wetlands that support or provide refuge for priority values in the 2009-2010 season under the following four low inflow scenarios:

- a repeat of 2006/07 (i.e. worst on record in most cases);
- 99% probability of exceedence Inflow (i.e 1 in 100 year event e.g. 1982-83);
- 95% probability of exceedence Inflow (i.e 1 in 20 year event); and
- 90% probability of exceedence Inflow (i.e 1 in 10 year event).
- The potential impact of the likely operation and environmental condition of the streams and wetlands on the priority values they support or provide refuge for in the 2009-2010 season under the four low inflow scenarios.

The four low inflow scenarios for the 2009-2010 season assume that 2008-09 stays dry until June 2009. In addition, each stream and wetland is considered in isolation when describing its likely operation, environmental condition and impact on priority values in the 2009-2010 season under the four low inflow scenarios.

### 3.1 Regulated Streams

#### 3.1.1 Broken and Boosey Creeks upstream of Katamatite Township

The operation and environmental conditions of the Broken and Boosey Creeks upstream of Katamatite Township during 2008-2009 are outlined below.

Operation during 2008-2009:

- Flow in the Broken Creek below Casey's Weir averaged 20 ML/day, which is approximately one fifth of the average flow.
- Flow in the Broken Creek below Waggarandal Weir averaged 0-5 ML/day, which is approximately one quarter of the average flow.
- There was no flow in the Boosey Creek above the Tungamah cross channel (the channel connects the Boosey Creek to the Broken Creek 4 km north of Tungamah Township).
- Flow in the Boosey Creek between the Tungamah cross channel and Katamatite Township was approximately 10-20 ML/day with potentially some zero flows.
- The irrigation allocation on the Broken Creek below Casey's Weir was 0% of licensed volume.

Environmental conditions during 2008-2009:

- Habitats within the Broken Creek channel were connected below Casey's Weir.
- Habitats within the Broken Creek channel between Waggarandal Weir and Katamatite Township were connected by low flows.
- Above the Tungamah cross channel the Boosey Creek was dry with intermittent small pools. As a result of the Tungamah pipeline project this section of the Boosey Creek has been returned to an ephemeral system and flows are expected to cease for extended periods during summer and autumn.
- Habitats within the Boosey Creek channel were connected below the Tungamah cross channel.
- Nuisance River Red Gum regeneration has occurred on the dry Creek beds
- No water quality issues (low DO levels, algal blooms, Azolla blooms and fish deaths) were identified.



The likely operation and environmental condition of the Broken and Boosey Creeks upstream of Katamatite Township in 2009-2010 under the four inflow scenarios are outlined in Tables 5 and 6 below.

Table 5 Operation of the Broken and Boosey Creeks.

Repeat of 2006-2007 Inflows	99% Probability of Exceedence Inflows	95% Probability of Exceedence Inflows	90% Probability of Exceedence Inflows
<ul style="list-style-type: none"> <li>No flow in the Broken Creek is expected throughout the year.</li> </ul>	<ul style="list-style-type: none"> <li>No flow in the Broken Creek is expected throughout the year.</li> </ul>	<ul style="list-style-type: none"> <li>No flow in the Broken Creek is expected throughout the year.</li> </ul>	<ul style="list-style-type: none"> <li>No flow in the Broken Creek is expected throughout the year.</li> </ul>
<ul style="list-style-type: none"> <li>No flow in the Boosey Creek is expected throughout the year.</li> </ul>	<ul style="list-style-type: none"> <li>No flow in the Boosey Creek is expected throughout the year.</li> </ul>	<ul style="list-style-type: none"> <li>No flow in the Boosey Creek is expected throughout the year.</li> </ul>	<ul style="list-style-type: none"> <li>No flow in the Boosey Creek is expected throughout the year.</li> </ul>
<ul style="list-style-type: none"> <li>No irrigation allocation will be available in the Broken Creek.</li> </ul>	<ul style="list-style-type: none"> <li>No irrigation allocation will be available in the Broken Creek.</li> </ul>	<ul style="list-style-type: none"> <li>No irrigation allocation will be available in the Broken Creek.</li> </ul>	<ul style="list-style-type: none"> <li>No irrigation allocation will be available in the Broken Creek.</li> </ul>

Table 6 Environmental conditions of the Broken and Boosey Creeks.

Repeat of 2006-2007 Inflows	99% Probability of Exceedence Inflows	95% Probability of Exceedence Inflows	90% Probability of Exceedence Inflows
<ul style="list-style-type: none"> <li>Habitats within the Broken Creek channel will be reduced to a series of isolated pools that may dry out in summer.</li> </ul>	<ul style="list-style-type: none"> <li>Habitats within the Broken Creek channel will be reduced to a series of isolated pools that may dry out in summer.</li> </ul>	<ul style="list-style-type: none"> <li>Habitats within the Broken Creek channel will be reduced to a series of isolated pools that may dry out in summer.</li> </ul>	<ul style="list-style-type: none"> <li>Habitats within the Broken Creek channel will be reduced to a series of isolated pools that may dry out in summer.</li> </ul>
<ul style="list-style-type: none"> <li>Habitats within the Boosey Creek channel will be reduced to a series of isolated pools that may dry out in summer.</li> </ul>	<ul style="list-style-type: none"> <li>Habitats within the Boosey Creek channel will be reduced to a series of isolated pools that may dry out in summer.</li> </ul>	<ul style="list-style-type: none"> <li>Habitats within the Boosey Creek channel will be reduced to a series of isolated pools that may dry out in summer.</li> </ul>	<ul style="list-style-type: none"> <li>Habitats within the Boosey Creek channel will be reduced to a series of isolated pools that may dry out in summer.</li> </ul>
<ul style="list-style-type: none"> <li>Freshes and high flow events will not occur.</li> </ul>	<ul style="list-style-type: none"> <li>Freshes and high flow events will not occur.</li> </ul>	<ul style="list-style-type: none"> <li>Freshes and high flow events will not occur.</li> </ul>	<ul style="list-style-type: none"> <li>Freshes may occur and high flow events will not occur.</li> </ul>
<ul style="list-style-type: none"> <li>Pools in the Broken Creek will be at risk of low DO levels and algal and Azolla blooms which may result in fish deaths.</li> </ul>	<ul style="list-style-type: none"> <li>Pools in the Broken Creek will be at risk of low DO levels and algal and Azolla blooms which may result in fish deaths.</li> </ul>	<ul style="list-style-type: none"> <li>Pools in the Broken Creek will be at risk of low DO levels and algal and Azolla blooms which may result in fish deaths.</li> </ul>	<ul style="list-style-type: none"> <li>Pools in the Broken Creek will be at risk of low DO levels and algal and Azolla blooms which may result in fish deaths.</li> </ul>
<ul style="list-style-type: none"> <li>No flow in the Broken Creek below Waggarandal Weir during summer is consistent with its environmental flow recommendations and on going management. However, no flow in the Broken Creek above Waggarandal Weir is inconsistent with its current and long term management. Therefore, it may have a greater impact on its ecological values, which are accustomed to permanent flow.</li> </ul>	<ul style="list-style-type: none"> <li>No flow in the Broken Creek below Waggarandal Weir during summer is consistent with its environmental flow recommendations and on going management. However, no flow in the Broken Creek above Waggarandal Weir is inconsistent with its current and long term management. Therefore, it may have a greater impact on its ecological values, which are accustomed to permanent flow.</li> </ul>	<ul style="list-style-type: none"> <li>No flow in the Broken Creek below Waggarandal Weir during summer is consistent with its environmental flow recommendations and on going management. However, no flow in the Broken Creek above Waggarandal Weir is inconsistent with its current and long term management. Therefore, it may have a greater impact on its ecological values, which are accustomed to permanent flow.</li> </ul>	<ul style="list-style-type: none"> <li>No flow in the Broken Creek below Waggarandal Weir during summer is consistent with its environmental flow recommendations and on going management. However, no flow in the Broken Creek above Waggarandal Weir is inconsistent with its current and long term management. Therefore, it may have a greater impact on its ecological values, which are accustomed to permanent flow.</li> </ul>
<ul style="list-style-type: none"> <li>Nuisance River Red Gum regeneration may occur on the dry Creek beds.</li> </ul>	<ul style="list-style-type: none"> <li>Nuisance River Red Gum regeneration may occur on the dry Creek beds.</li> </ul>	<ul style="list-style-type: none"> <li>Nuisance River Red Gum regeneration may occur on the dry Creek beds.</li> </ul>	<ul style="list-style-type: none"> <li>Nuisance River Red Gum regeneration may occur on the dry Creek beds.</li> </ul>

## Key Points:

- No flow is expected throughout the year in the Creeks under all inflow scenarios.
- No irrigation allocation will be available in the Broken Creek under all inflow scenarios.
- Habitat within the Creeks will be reduced to a series of isolated pools that may dry out in summer.
- Remnant pools will be at risk from low DO levels, algal blooms, and Azolla blooms, which may result in fish deaths.
- Nuisance River Red Gum regeneration may occur on the dry Creek beds.

### 3.1.2 Broken and Nine Mile Creeks downstream of Katamatite

The operation and environmental conditions of the Broken and Nine Mile Creeks downstream of Katamatite Township during 2008-2009 are outlined below.

Operation during 2008-2009:

- Flow was approximately 50-100 ML/d between Katamatite and the Murray River.
- Fish ladders were operating (Katandra Weir to Rice's Weir).
- The irrigation allocation was approximately 33% of licensed volume (Murray allocation).

Environmental conditions during 2008-2009:

- Habitats within the channel were connected.
- As in previous years Azolla blooms occurred between Nathalia and Rice's Weir between August and November 2008.
- Dissolved oxygen concentrations below 4mg/L were recorded on a number of occasions at Rice's Weir. However, no impacts on oxygen dependent fauna were identified.

The likely operation and environmental condition of the Broken and Nine Mile Creeks downstream of Katamatite Township in 2009-2010 under the four inflow scenarios are outlined in Tables 7 and 8 below.

Table 7 Operation of the Broken and Nine Mile Creeks.

Repeat of 2006-2007 Inflows	99% Probability of Exceedence Inflows	95% Probability of Exceedence Inflows	90% Probability of Exceedence Inflows
<ul style="list-style-type: none"> <li>• No water will be supplied to the Broken Creek from the Goulburn River system.</li> </ul>	<ul style="list-style-type: none"> <li>• No water will be supplied to the Broken Creek from the Goulburn River system.</li> </ul>	<ul style="list-style-type: none"> <li>• No water will be supplied to the Broken Creek from the Goulburn River system.</li> </ul>	<ul style="list-style-type: none"> <li>• No water will be supplied to the Broken Creek from the Goulburn River system.</li> </ul>
<ul style="list-style-type: none"> <li>• No flow is expected along the system throughout the year.</li> </ul>	<ul style="list-style-type: none"> <li>• No flow is expected along the system throughout the year.</li> </ul>	<ul style="list-style-type: none"> <li>• No flow is expected along the system throughout the year.</li> </ul>	<ul style="list-style-type: none"> <li>• No flow is expected along the system throughout the year.</li> </ul>
<ul style="list-style-type: none"> <li>• Numurkah and Nathalia weir pools maintained for urban use. No other water supply needs will be met.</li> </ul>	<ul style="list-style-type: none"> <li>• Numurkah and Nathalia weir pools maintained for urban use. No other water supply needs will be met.</li> </ul>	<ul style="list-style-type: none"> <li>• Numurkah and Nathalia weir pools maintained for urban use. No other water supply needs will be met.</li> </ul>	<ul style="list-style-type: none"> <li>• Numurkah and Nathalia weir pools maintained for urban use. No other water supply needs will be met.</li> </ul>
<ul style="list-style-type: none"> <li>• Fish ladders will not operate.</li> </ul>	<ul style="list-style-type: none"> <li>• Fish ladders will not operate.</li> </ul>	<ul style="list-style-type: none"> <li>• Fish ladders will not operate.</li> </ul>	<ul style="list-style-type: none"> <li>• Fish ladders will not operate.</li> </ul>
<ul style="list-style-type: none"> <li>• Domestic and stock water will be carted.</li> </ul>	<ul style="list-style-type: none"> <li>• Domestic and stock water will be carted.</li> </ul>	<ul style="list-style-type: none"> <li>• Domestic and stock water will be carted.</li> </ul>	<ul style="list-style-type: none"> <li>• Domestic and stock water will be carted.</li> </ul>



Table 8 Environmental conditions of the Broken and Nine Mile Creeks.

Repeat of 2006-2007 Inflows	99% Probability of Exceedence Inflows	95% Probability of Exceedence Inflows	90% Probability of Exceedence Inflows
<ul style="list-style-type: none"> <li>The creeks will be largely reduced to a series of small isolated pools throughout the year with some water also retained in the original creek channels. Large volumes of water will be maintained in Numurkah and Nathalia weir pools.</li> </ul>	<ul style="list-style-type: none"> <li>The creeks will be largely reduced to a series of small isolated pools throughout the year with some water also retained in the original creek channels. Large volumes of water will be maintained in Numurkah and Nathalia weir pools.</li> </ul>	<ul style="list-style-type: none"> <li>The creeks will be largely reduced to a series of small isolated pools throughout the year with some water also retained in the original creek channels. Large volumes of water will be maintained in Numurkah and Nathalia weir pools.</li> </ul>	<ul style="list-style-type: none"> <li>The creeks will be largely reduced to a series of small isolated pools throughout the year with some water also retained in the original creek channels. Large volumes of water will be maintained in Numurkah and Nathalia weir pools.</li> </ul>
<ul style="list-style-type: none"> <li>Freshes and high flow events will not occur.</li> </ul>	<ul style="list-style-type: none"> <li>Freshes and high flow events will not occur.</li> </ul>	<ul style="list-style-type: none"> <li>Freshes and high flow events will not occur.</li> </ul>	<ul style="list-style-type: none"> <li>Freshes and high flow events will not occur.</li> </ul>
<ul style="list-style-type: none"> <li>Pools are at high risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths (particularly at Rices Weir). Large loss of fish habitat below Nathalia.</li> </ul>	<ul style="list-style-type: none"> <li>Pools are at high risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths (particularly at Rices Weir). Large loss of fish habitat below Nathalia.</li> </ul>	<ul style="list-style-type: none"> <li>Pools are at high risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths (particularly at Rices Weir). Large loss of fish habitat below Nathalia.</li> </ul>	<ul style="list-style-type: none"> <li>Pools are at high risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths (particularly at Rices Weir). Large loss of fish habitat below Nathalia.</li> </ul>
<ul style="list-style-type: none"> <li>Exposed aquatic weeds may be readily controlled or eradicated.</li> </ul>	<ul style="list-style-type: none"> <li>Exposed aquatic weeds may be readily controlled or eradicated.</li> </ul>	<ul style="list-style-type: none"> <li>Exposed aquatic weeds may be readily controlled or eradicated.</li> </ul>	<ul style="list-style-type: none"> <li>Exposed aquatic weeds may be readily controlled or eradicated.</li> </ul>
<ul style="list-style-type: none"> <li>Loss of riparian vegetation and habitat.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of riparian vegetation and habitat.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of riparian vegetation and habitat.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of riparian vegetation and habitat.</li> </ul>
<ul style="list-style-type: none"> <li>Nuisance River Red Gum regeneration may occur on the dry Creek beds.</li> </ul>	<ul style="list-style-type: none"> <li>Nuisance River Red Gum regeneration may occur on the dry Creek beds.</li> </ul>	<ul style="list-style-type: none"> <li>Nuisance River Red Gum regeneration may occur on the dry Creek beds.</li> </ul>	<ul style="list-style-type: none"> <li>Nuisance River Red Gum regeneration may occur on the dry Creek beds.</li> </ul>

## Key Points

- No flow is expected throughout the year in the Creeks under all inflow scenarios.
- No irrigation allocation will be available in the Broken Creek under all inflow scenarios.
- Habitat within the Creeks will be reduced to a series of isolated pools that may dry out in summer.
- Large volumes of water will be maintained in Numurkah and Nathalia weir pools.
- Remnant pools (particularly at Rices Weir) will be at risk from low DO levels, algal blooms, and Azolla blooms, which may result in fish deaths.
- Nuisance River Red Gum regeneration may occur on the dry Creek beds.

### 3.1.3 Broken River

The operation and environmental conditions of the Broken River during 2008-2009 are outlined below.

Operation during 2008-2009:

- Flow was approximately 10-20 ML/day between Lake Nillahcootie and Casey's Weir and 40 ML/day between Casey's Weir and the Goulburn River. Under normal summer conditions, the average flow in these sections of the River is 130 ML/day and 300 ML/day respectively.
- The irrigation allocation was 0% of licensed volume.
- Fish ladders were operating (Casey's Weir and Benalla Weir).

Environmental conditions during 2008-2009:

- Habitats within the Broken River channel were connected by low flow for the majority of the year. Three cease to flow events occurred during summer 2009. One event in January 2009 resulted in the lower Broken River drying up for a short period of time.
- Fringing River Red Gums (*Eucalyptus camaldulensis*) are showing signs of stress due to below average rainfall over the past number of years and no recent flooding (i.e. depleted canopy cover).
- No water quality issues (low DO levels, algal blooms, Azolla blooms and fish deaths) were identified.

The likely operation and environmental condition of the Broken and Nine Mile Creeks downstream of Katamatite Township in 2009-2010 under the four inflow scenarios are outlined in Tables 9 and 10 below.

Table 9 Operation of the Broken River.

Repeat of 2006-2007 Inflows	99% Probability of Exceedence Inflows	95% Probability of Exceedence Inflows	90% Probability of Exceedence Inflows
<ul style="list-style-type: none"> <li>• No flow is expected throughout the year between Lake Nillahcootie and the Goulburn River.</li> </ul>	<ul style="list-style-type: none"> <li>• No flow is expected throughout the year between Lake Nillahcootie and the Goulburn River.</li> </ul>	<ul style="list-style-type: none"> <li>• No flow is expected throughout the year between Lake Nillahcootie and the Goulburn River.</li> </ul>	<ul style="list-style-type: none"> <li>• No flow is expected throughout the year between Lake Nillahcootie and the Goulburn River.</li> </ul>
<ul style="list-style-type: none"> <li>• Fish ladders will not operate (Casey's Weir and Benalla Weir).</li> </ul>	<ul style="list-style-type: none"> <li>• Fish ladders will not operate (Casey's Weir and Benalla Weir).</li> </ul>	<ul style="list-style-type: none"> <li>• Fish ladders will not operate (Casey's Weir and Benalla Weir).</li> </ul>	<ul style="list-style-type: none"> <li>• Fish ladders will not operate (Casey's Weir and Benalla Weir).</li> </ul>
<ul style="list-style-type: none"> <li>• No irrigation allocation will be available.</li> </ul>	<ul style="list-style-type: none"> <li>• No irrigation allocation will be available.</li> </ul>	<ul style="list-style-type: none"> <li>• No irrigation allocation will be available.</li> </ul>	<ul style="list-style-type: none"> <li>• No irrigation allocation will be available.</li> </ul>
<ul style="list-style-type: none"> <li>• Domestic and stock water will be carted.</li> </ul>	<ul style="list-style-type: none"> <li>• Domestic and stock water will be carted.</li> </ul>	<ul style="list-style-type: none"> <li>• Domestic and stock water will be carted.</li> </ul>	<ul style="list-style-type: none"> <li>• Domestic and stock water will be carted.</li> </ul>

Table 10 Environmental conditions of the Broken River.

Repeat of 2006-2007 Inflows	99% Probability of Exceedence Inflows	95% Probability of Exceedence Inflows	90% Probability of Exceedence Inflows
<ul style="list-style-type: none"> <li>• Habitats within the Broken River channel will be reduced to a series of isolated pools. Smaller pools may dry out in summer.</li> </ul>	<ul style="list-style-type: none"> <li>• Habitats within the Broken River channel will be reduced to a series of isolated pools. Smaller pools may dry out in summer.</li> </ul>	<ul style="list-style-type: none"> <li>• Habitats within the Broken River channel will be reduced to a series of isolated pools. Smaller pools may dry out in summer.</li> </ul>	<ul style="list-style-type: none"> <li>• Habitats within the Broken River channel will be reduced to a series of isolated pools. Smaller pools may dry out in summer.</li> </ul>
<ul style="list-style-type: none"> <li>• Pools will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.</li> </ul>	<ul style="list-style-type: none"> <li>• Pools will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.</li> </ul>	<ul style="list-style-type: none"> <li>• Pools will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.</li> </ul>	<ul style="list-style-type: none"> <li>• Pools will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.</li> </ul>
<ul style="list-style-type: none"> <li>• Freshes and high flow events will not occur.</li> </ul>	<ul style="list-style-type: none"> <li>• Freshes and high flow events will not occur.</li> </ul>	<ul style="list-style-type: none"> <li>• Freshes and high flow events will not occur.</li> </ul>	<ul style="list-style-type: none"> <li>• Freshes and high flow events will not occur.</li> </ul>

Table 10 (continued).

Repeat of 2006-2007 Inflows	99% Probability of Exceedence Inflows	95% Probability of Exceedence Inflows	90% Probability of Exceedence Inflows
<ul style="list-style-type: none"> <li>Exposed aquatic weeds may be readily controlled or eradicated.</li> </ul>	<ul style="list-style-type: none"> <li>Exposed aquatic weeds may be readily controlled or eradicated.</li> </ul>	<ul style="list-style-type: none"> <li>Exposed aquatic weeds may be readily controlled or eradicated.</li> </ul>	<ul style="list-style-type: none"> <li>Exposed aquatic weeds may be readily controlled or eradicated.</li> </ul>
<ul style="list-style-type: none"> <li>Loss of riparian vegetation and habitat.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of riparian vegetation and habitat.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of riparian vegetation and habitat.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of riparian vegetation and habitat.</li> </ul>
<ul style="list-style-type: none"> <li>Nuisance River Red Gum regeneration may occur on dry areas of the River bed.</li> </ul>	<ul style="list-style-type: none"> <li>Nuisance River Red Gum regeneration may occur on dry areas of the River bed.</li> </ul>	<ul style="list-style-type: none"> <li>Nuisance River Red Gum regeneration may occur on dry areas of the River bed.</li> </ul>	<ul style="list-style-type: none"> <li>Nuisance River Red Gum regeneration may occur on dry areas of the River bed.</li> </ul>

## Key Points:

- **No flow is expected throughout the year in the River under all inflow scenarios.**
- **No irrigation allocation will be available in River under all inflow scenarios.**
- **Habitat within the River will be reduced to a series of isolated pools. Smaller pools may dry out in summer.**
- **Remnant pools will be at risk from low DO levels, algal blooms, and Azolla blooms, which may result in fish deaths.**
- **Nuisance River Red Gum regeneration may occur on dry areas of the River bed.**

### 3.1.4 Goulburn River (Lake Eildon to the Murray River)

The operation and environmental conditions of the Goulburn River during 2008-2009 are outlined below.

Operation during 2008-2009:

- Flow was approximately 1500 ML/day between Lake Eildon and the Goulburn Weir, which is consistent with the summer environmental flow recommendations (Cottingham et. al. 2003). Under normal summer conditions, the average flow in the Goulburn River is kept at approximately 10,000 ML/day to meet the needs of irrigators.
- Flow was approximately 450 ML/day between the Goulburn Weir and the Murray River, which is below the recommended minimum flow of 610 ML/day for spring and summer (Cottingham et. al. 2003). Qualification of rights resulted in flows reduced down to 250 ML/d from August to October.
- Goulburn Weir operated between 96- 99% of its full supply level.
- Waranga Basin operated between 29% and 31% full to the end of March 2009. It was then pumped down to 13% of its full supply level, which was reached in May 2009.
- Greens Lake was approximately 53% full by the end of March 2009.
- The irrigation allocation was 33% of water rights and licensed volume. This was the third time in the last 45 years the irrigation allocation has been below 100%.

Environmental conditions during 2008-2009:

- Habitats within the channel were connected.
- Increased shallow water habitat favoured by in-channel macrophytes and small fish.
- Fringing River Red Gums (*Eucalyptus camaldulensis*) showed signs of stress (i.e. depleted canopy cover) due to below average rainfall over the past number of years and no recent flooding.

- The temperature of the water released from Lake Eildon has increased from 15-18°C in November to 19-21°C in March. Normally the temperature of the water released from Lake Eildon in spring and summer is 10-15°C. The temperature of the water downstream of Lake Eildon is also expected to be higher than average due to the increased temperature of the water released from Lake Eildon and the low flows.

The likely operation and environmental condition of the Goulburn River in 2009-2010 under the four inflow scenarios are outlined in Tables 11 and 12 below.

Table 11 Operation of the Goulburn River.

Repeat of 2006-2007 Inflows	99% Probability of Exceedence Inflows	95% Probability of Exceedence Inflows	90% Probability of Exceedence Inflows
<ul style="list-style-type: none"> <li>• Throughout the year flow is expected to be approximately 500 ML/d between Lake Eildon and the Goulburn Weir. Normally flow from July to October inclusive is X and from November to June inclusive is X.</li> <li>• The minimum average monthly flow at McCoys Bridge (below Shepparton) will be 200 ML/d from July to October inclusive at a daily rate of no less than 150 ML/d. This represents 50% of the recommended minimum flow (400 ML/d) for this period.</li> </ul>	<ul style="list-style-type: none"> <li>• Throughout the year flow is expected to be approximately 1000 ML/d between Lake Eildon and the Goulburn Weir. Normally flow from July to October inclusive is X and from November to June inclusive is X.</li> <li>• The minimum average monthly flow at McCoys Bridge (below Shepparton) will be 250 ML/d from July to October inclusive at a daily rate of no less than 200 ML/d. This represents 62.5% of the recommended minimum flow (400 ML/d) for this period.</li> </ul>	<ul style="list-style-type: none"> <li>• Throughout the year flow is expected to be approximately 1500 ML/d between Lake Eildon and the Goulburn Weir. Normally flow from July to October inclusive is X and from November to June inclusive is X.</li> <li>• As required under the provisions of Goulburn-Murray's bulk water entitlement, the minimum average monthly flow at McCoys Bridge (below Shepparton) of 400 ML/d from July to October inclusive will be met.</li> </ul>	<ul style="list-style-type: none"> <li>• Flow is expected to be between 1000-5000 ML/d between Lake Eildon and the Goulburn Weir from July to October inclusive and between 3000-4000 ML/d from November to June inclusive.</li> <li>• As required under the provisions of Goulburn-Murray's bulk water entitlement, the minimum average monthly flow at McCoys Bridge (below Shepparton) of 400 ML/d from July to October inclusive will be met. Higher flows are possible due to inter valley transfers.</li> </ul>
<ul style="list-style-type: none"> <li>• The minimum average monthly flow at McCoys Bridge (below Shepparton) will be 300ML/d from November to June inclusive at a daily rate of no less than 250 ML/d. This represents 85.7% of the recommended minimum flow (350 ML/d) for this period.</li> </ul>	<ul style="list-style-type: none"> <li>• The minimum average monthly flow at McCoys Bridge (below Shepparton) will be 300ML/d from November to June inclusive at a daily rate of no less than 250 ML/d. This represents 85.7% of the recommended minimum flow (350 ML/d) for this period.</li> </ul>	<ul style="list-style-type: none"> <li>• As required under the provisions of Goulburn-Murray's bulk water entitlement, the minimum average monthly flow at McCoys Bridge (below Shepparton) of 350 ML/d from July to October will be met.</li> </ul>	<ul style="list-style-type: none"> <li>• As required under the provisions of Goulburn-Murray's bulk water entitlement, the minimum average monthly flow at McCoys Bridge (below Shepparton) of 350 ML/d from July to October will be met. Higher flows are possible due to inter valley transfers.</li> </ul>
<ul style="list-style-type: none"> <li>• Waranga Basin may be drawn down to 10 GL (near empty) to provide additional water for consumptive use.</li> </ul>	<ul style="list-style-type: none"> <li>• Waranga Basin may be drawn down to 10 GL (near empty) to provide additional water for consumptive use.</li> </ul>	<ul style="list-style-type: none"> <li>• Waranga Basin will be drawn down to 38 GL to provide additional water for consumptive use.</li> </ul>	<ul style="list-style-type: none"> <li>• Waranga Basin will be drawn down to 38 GL to provide additional water for consumptive use.</li> </ul>
<ul style="list-style-type: none"> <li>• There will not be enough water to fully operate channel delivery systems for irrigation or domestic and stock supply. Only channels that supply towns will operate.</li> </ul>	<ul style="list-style-type: none"> <li>• There will not be enough water to fully operate channel delivery systems for irrigation or domestic and stock supply. Only channels that supply towns will operate.</li> </ul>	<ul style="list-style-type: none"> <li>• Most channels will operate.</li> </ul>	<ul style="list-style-type: none"> <li>• Most channels will operate.</li> </ul>

Table 11 (continued).

Repeat of 2006-2007 Inflows	99% Probability of Exceedence Inflows	95% Probability of Exceedence Inflows	90% Probability of Exceedence Inflows
<ul style="list-style-type: none"> <li>20 GL may be available for water quality management in the lower Goulburn River (see Appendix 1). It may be used to manage water quality in the lower Broken Creek if it is not required in the lower Goulburn River.</li> </ul>	<ul style="list-style-type: none"> <li>20 GL may be available for water quality management in the lower Goulburn River (see Appendix 1). It may be used to manage water quality in the lower Broken Creek if it is not required in the lower Goulburn River.</li> </ul>	<ul style="list-style-type: none"> <li>20 GL may be available for water quality management in the lower Goulburn River (see Appendix 1). It may be used to manage water quality in the lower Broken Creek if it is not required in the lower Goulburn River.</li> </ul>	<ul style="list-style-type: none"> <li>20 GL may be available for water quality management in the lower Goulburn River (see Appendix 1). It may be used to manage water quality in the lower Broken Creek if it is not required in the lower Goulburn River.</li> </ul>
<ul style="list-style-type: none"> <li>The Goulburn Weir maybe lowered to approximately 90% of its full supply level.</li> </ul>	<ul style="list-style-type: none"> <li>The Goulburn Weir maybe lowered to approximately 90% of its full supply level.</li> </ul>	<ul style="list-style-type: none"> <li>The Goulburn Weir will operate at near normal supply level.</li> </ul>	<ul style="list-style-type: none"> <li>The Goulburn Weir will operate at near normal supply level.</li> </ul>
<ul style="list-style-type: none"> <li>Urban centres will receive restricted allocations. Towns supplied by channels will require water to be maintained in weir pools and refilled occasionally.</li> </ul>	<ul style="list-style-type: none"> <li>Urban centres will receive restricted allocations. Towns supplied by channels will require water to be maintained in weir pools and refilled occasionally.</li> </ul>	<ul style="list-style-type: none"> <li>Urban centres may receive restricted allocations.</li> </ul>	<ul style="list-style-type: none"> <li>Urban centres may receive restricted allocations.</li> </ul>
<ul style="list-style-type: none"> <li>Greens Lake TBD</li> </ul>	<ul style="list-style-type: none"> <li>Greens Lake TBD</li> </ul>	<ul style="list-style-type: none"> <li>Greens Lake TBD</li> </ul>	<ul style="list-style-type: none"> <li>Greens Lake TBD</li> </ul>
<ul style="list-style-type: none"> <li>No irrigation allocation will be available. Carry over?</li> </ul>	<ul style="list-style-type: none"> <li>No irrigation allocation will be available. Carry over?</li> </ul>	<ul style="list-style-type: none"> <li>The irrigation allocation will be approximately 20% of water rights and licensed volume.</li> </ul>	<ul style="list-style-type: none"> <li>The irrigation allocation will be approximately 48% of water rights and licensed volume.</li> </ul>

Table 12 Environmental conditions of the Goulburn River.

Repeat of 2006-2007 Inflows	99% Probability of Exceedence Inflows	95% Probability of Exceedence Inflows	90% Probability of Exceedence Inflows
<ul style="list-style-type: none"> <li>Freshes are not expected below the Goulburn Weir. Some winter and spring freshes above the Goulburn Weir are expected.</li> </ul>	<ul style="list-style-type: none"> <li>Freshes are not expected below the Goulburn Weir. Some winter and spring freshes above the Goulburn Weir are expected.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced frequency and duration of freshes between Lake Eildon and the Murray River.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced frequency and duration of freshes between Lake Eildon and the Murray River.</li> </ul>
<ul style="list-style-type: none"> <li>High flow events are not expected.</li> </ul>	<ul style="list-style-type: none"> <li>High flow events are not expected.</li> </ul>	<ul style="list-style-type: none"> <li>High flows are not expected.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced frequency and duration of high flow events between Lake Eildon and the Goulburn Weir. High flow events are not expected between the Goulburn Weir and the Murray River.</li> </ul>
<ul style="list-style-type: none"> <li>Limited connectivity will be maintained between habitats within the Goulburn River channel throughout the year. The passage of large fish may be restricted.</li> </ul>	<ul style="list-style-type: none"> <li>Limited connectivity will be maintained between habitats within the Goulburn River channel throughout the year. The passage of large fish may be restricted.</li> </ul>	<ul style="list-style-type: none"> <li>Connectivity between habitats within the channel will be maintained throughout the year between Lake Eildon and the Goulburn Weir.</li> </ul>	<ul style="list-style-type: none"> <li>Connectivity between habitats within the Goulburn River channel will be maintained throughout the year between Lake Eildon and the Goulburn Weir.</li> </ul>
<ul style="list-style-type: none"> <li>Increased shallow water habitat favoured by in-channel macrophytes and small fish.</li> </ul>	<ul style="list-style-type: none"> <li>Increased shallow water habitat favoured by in-channel macrophytes and small fish.</li> </ul>	<ul style="list-style-type: none"> <li>Connectivity between habitats within the channel will be maintained throughout the year between the Goulburn Weir and the Murray River.</li> </ul>	<ul style="list-style-type: none"> <li>Connectivity between habitats within the Goulburn River channel will be maintained throughout the year between the Goulburn Weir and the Murray River.</li> </ul>

Table 12 (continued).

Repeat of 2006-2007 Inflows	99% Probability of Exceedence Inflows	95% Probability of Exceedence Inflows	90% Probability of Exceedence Inflows
<ul style="list-style-type: none"> <li>Elevated water temperatures and low dissolved oxygen levels are a risk and may impact on aquatic fauna.</li> </ul>	<ul style="list-style-type: none"> <li>Elevated water temperatures and low dissolved oxygen levels are a risk and may impact on aquatic fauna.</li> </ul>	<ul style="list-style-type: none"> <li>The risk of elevated water temperatures and low dissolved oxygen levels impacting on native aquatic fauna is low.</li> </ul>	<ul style="list-style-type: none"> <li>The risk of elevated water temperatures and low dissolved oxygen levels impacting on native aquatic fauna is low.</li> </ul>
<ul style="list-style-type: none"> <li>Higher than normal water temperatures below Lake Eildon may not support Trout.</li> </ul>	<ul style="list-style-type: none"> <li>Higher than normal water temperatures below Lake Eildon may not support Trout.</li> </ul>	<ul style="list-style-type: none"> <li>The risk of water temperatures below Lake Eildon being higher than normal and not supporting Trout is low.</li> </ul>	<ul style="list-style-type: none"> <li>The risk of water temperatures below Lake Eildon being higher than normal and not supporting Trout is low.</li> </ul>
<ul style="list-style-type: none"> <li>Loss of riparian vegetation and habitat.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of riparian vegetation and habitat.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of riparian vegetation and habitat.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of riparian vegetation and habitat.</li> </ul>
<ul style="list-style-type: none"> <li>Exposed aquatic weeds may be readily controlled or eradicated.</li> </ul>	<ul style="list-style-type: none"> <li>Exposed aquatic weeds may be readily controlled or eradicated.</li> </ul>	<ul style="list-style-type: none"> <li>Exposed aquatic weeds may be readily controlled or eradicated.</li> </ul>	<ul style="list-style-type: none"> <li>Exposed aquatic weeds may be readily controlled or eradicated.</li> </ul>

## Key Points:

- Flows are expected to be significantly reduced throughout the year under the 2006-2007 and 99% probability of exceedence inflow scenarios and minimum flow requirements will not be met at McCoy's Bridge.
- Reduced flows are expected throughout the year under the 95% and 90% probability of exceedence inflow scenarios. However minimum flow requirements will be met at McCoy's Bridge.
- No irrigation allocation will be available under the 2006-2007 and 99% probability of exceedence inflow scenarios.
- Habitats within the channel will be maintained throughout the year. However, deep water habitat for large native fish may be reduced under the 2006/07 and 99% probability of exceedence inflow scenarios.
- Higher than normal water temperatures below Lake Eildon may not support Trout under the 2006-2007 and 99% probability of exceedence inflow scenarios.
- Elevated water temperatures and low dissolved oxygen levels may impact on aquatic fauna under the 2006-2007 and 99% probability of exceedence inflow scenarios.

### 3.2 Unregulated Streams

The flow status in the 2008-2009 season, system operation and likely flow status in the 2009-2010 season under the four inflow scenarios of the unregulated streams are summarised below in Table 13. The flow status of the Big River is listed as unknown as the Kilmore East – Murrindindi Complex North Fire restricted access to the river at the time this information was collected.

Table 13 2008-2009 season flow status, system operation and likely flow status in the 2009-2010 season under the four inflow scenarios of unregulated streams that support or provide refuge for priority ecological values.

Stream	Reach	Urban Water Supply	Current Flow Status (Feb 2009)	Current System Operation (Feb 2009)	Inflow Scenarios			
					2006/07	99%	95%	90%
Acheron River	62	No	LF		LF	LF	LF	NNF
	63	No	LF		LF	LF	LF	NNF
Big River	67	No	Unknown		LF	LF	LF	NNF
	68	No	Unknown		LF	LF	LF	NNF
Delatite River	71	Yes	LF		LF	LF	LF	NNF
	72	Yes	LF		LF	LF	LF	NNF
Goulburn River	15	No	LF		LF	LF	LF	NNF
	16	No	LF		LF	LF	LF	NNF
Holland Creek	13	No	NF2	IS	NF2	LF	LF	NNF
	14	No	LF	IS	LF	LF	LF	NNF
	15	No	NF2	IS	NF2	LF	LF	NNF
Howqua River	69	No	LF		LF	LF	LF	NNF
	70	No	LF		LF	LF	LF	NNF
Hughes Creek	37	No	NF2		NF2	LF	LF	NNF
	38	No	NF2		NF2	LF	LF	NNF
	39	No	LF		LF	LF	LF	NNF
King Parrot Creek	51	Yes	NF2		NF2	LF	LF	NNF
	52	Yes	LF		LF	LF	LF	NNF
Leary's Creek	NA	No	LF		LF	LF	LF	NNF
Rubicon River	65	No	LF		LF	LF	LF	NNF
	66	No	LF		LF	LF	LF	NNF
Ryans Creek	16	Yes	LF-NF1		LF-NF1	LF	LF	NNF
	17	Yes	LF		LF	LF	LF	NNF
Seven Creeks	17	Yes	NF2		NF2	LF	LF	NNF
	18	Yes	NF2		NF2	LF	LF	NNF
	19	Yes	NF2		NF2	LF	LF	NNF
	20	Yes	LF		LF	LF	LF	NNF
Steavenson River	NA	No	LF		LF	LF	LF	NNF
Sunday Creek	NA	No	NF2	IS	NF2	LF	LF	NNF
Taggerty River	64	No	LF		LF	LF	LF	NNF
Yea River	54	Yes	LF		LF	LF	LF	NNF
	55	Yes	LF		LF	LF	LF	NNF
	56	Yes	LF		LF	LF	LF	NNF
	57	Yes	LF		LF	LF	LF	NNF

BF (Bankfull)	High flow within channel capacity and in-stream habitats connected
HF (High flow)	Less than bankfull and in-stream habitats connected
IS	Irrigation suspended
LF (Low flow)	Minimum flow in channel/continuous flow in some part of channel (in-stream habitats connected)
NA	Not applicable
NF1 (No flow 1)	No continuous flow in channel and no pools
NF2 (No flow 2)	No continuous flow in channel and intermittent pools (in-stream habitats not connected)
NF3 (No flow 3)	No continuous flow in channel and continuous pools (in-stream habitats connected)
NNF	Near normal flows
FSL	Full supply level

Due to the large number of unregulated streams considered in the Plan, their environmental condition during the 2008-2009 season under the four inflow scenarios is discussed collectively.

#### 3.2.1 Environmental conditions during 2008-2009

In stream habitats were connected in the majority of priority unregulated streams at the time of their assessment. However, Hughes Creek and the Seven Creeks have been affected by poor water quality and a number of streams have been affected by the Kilmore East – Murrindindi Complex North Fire (Figure 5). This has impacted native fish populations, instream and riparian habitats, and catchment hydrology.

In response to poor water quality threatening the survival of Macquarie Perch in the Hughes Creek, scientists from DSE's Arthur Rylah Institute (ARI) translocated 32 fish to Snobs Creek fish hatchery (Table 14). The poor water quality recorded in the Creek is thought to be the result of warm temperatures and low flow. A recent (April 2009) survey of native fish in the Seven Creeks by ARI indicated that the distribution and number of Trout Cod and Maquarie Perch had contracted since the last survey in 2008. A number of fish showed signs of stress (including infestations of the parasitic Anchor worm *Lernaea* sp.) due to the reduced availability of suitable habitat. Currently, there is no capacity to house these fish at alternative sites (e.g. Snobs Creek and ARI).

The Kilmore East – Murrindindi Complex North Fire was first reported on Saturday 7 February 2009 and burnt approximately 252,000 ha. A total of 188,000 ha was burnt in the Goulburn Broken Catchment affecting 10 priority unregulated streams (see Table 15 and Figure5). Until the vegetation and soils sufficiently recover over the next 2-3 years a significant increase in stream flow is expected, with the potential for large increases in sediment loading and flooding (BAER Team 2009). However, prolonged drought conditions may further delay this recovery. In the longer term, stream flow is expected to decrease as regenerating forests use more water than mature forests. In response, water quality monitoring sites on a number of key unregulated streams in the fire affected area are being upgraded to provide real time monitoring. In addition, ARI scientists have removed Barred Galaxias and Macquarie Perch from a number of streams in the fire affected area in anticipation of their habitat being affected by post-fire sediment and ash slugs.

Table 14 Native fish translocations.

Stream	Fish Species	Number Removed	Site Held
Hughes Creek	Macquarie Perch	32	Snobs Creek
Keppel Hut Creek	Barred Galaxias	45	ARI
King Parrot Creek	Macquarie Perch	35	Snobs Creek
Leary's Creek	Barred Galaxias	TBD	ARI
Luke Creek	Barred Galaxias	80	ARI
Robertson Gully	Barred Galaxias	4	ARI
Rubicon River	Barred Galaxias	90	ARI
Sunday Creek*	Barred Galaxias	TBD	ARI
Taggerty River	Barred Galaxias	76	ARI

\* Barred Galaxias were also translocated from Sunday Creek in the 2007/2008 season and are still been held at ARI.  
Note: fish will be held until suitable habitat returns or the threat to their habitat is sufficiently reduced.

Table 15 Streams affected by fire.

Stream	Total Length (km)	Length in the Fire Affected Area (km)	% of the Total Length in the Fire Affected Area
Acheron River	76.01	53.46	70.34
Big River	71.93	4.36	6.06
Dry Creek	57.13	24.02	42.04
King Parrot Creek	54.58	18.22	33.38
Leary's Creek	36.50	12.76	34.95
Rubicon River	18.75	0.30	1.59
Steavenson River	23.08	23.08	100.00
Sunday Creek	57.05	22.66	39.71
Taggerty River	17.64	17.64	100.00
Yea River	85.99	24.83	28.87

### 3.2.2 Environmental conditions under the four Inflow Scenarios

Environmental condition under the 2006-2007 Inflow Scenarios:

- In stream habitats will be connected in the majority of priority unregulated streams.
- Freshes and high flow events will not occur.
- Hughes Creek and Seven Creeks catchments not affected by recent fires will be at risk of wildfire in summer.
- Streams in fire affected areas will be at risk of low dissolved oxygen levels, algal and Azolla blooms as a result of increased ash and sediment loads, which may result in fish deaths.
- Pools on streams will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.

Environmental conditions under the 99% Probability of Exceedence Inflow Scenario:

- In stream habitats will be connected.
- The frequency and duration of freshes will be reduced.
- High flows will not occur.
- Hughes Creek and Seven Creeks catchments not affected by recent fires will be at risk of wildfire in summer.
- Streams in fire affected areas will be at risk of low dissolved oxygen levels, algal and Azolla blooms as a result of increased ash and sediment loads, which may result in fish deaths.
- Significant water quality issues are not expected outside the fire affected area.



Environmental conditions under the 95% Probability of Exceedence Inflow Scenario:

- In stream habitats will be connected.
- The frequency and duration of freshes will be reduced.
- High flow events will not occur.
- Hughes Creek and Seven Creeks catchments not affected by recent fires will be at risk of wildfire in summer.
- Streams in fire affected areas will be at risk of low dissolved oxygen levels, algal and Azolla blooms as a result of increased ash and sediment loads, which may result in fish deaths.
- Significant water quality issues are not expected outside the fire affected area.

Environmental conditions under the 90% Probability of Exceedence Inflow Scenario:

- In stream habitats will be connected.
- The frequency and duration of freshes and high flow events will be reduced.
- Hughes Creek and Seven Creeks catchments not affected by recent fires will be at risk of wildfire in summer.
- Streams in fire affected areas will be at risk of low dissolved oxygen levels, algal and Azolla blooms as a result of increased ash and sediment loads, which may result in fish deaths.
- Significant water quality issues are not expected.

### 3.3 Wetlands

#### 3.3.1 Operation

Of the wetlands that support or provide refuge for priority ecological values only Greens Lake and Tahbilk Lagoon are used as active water storages. Greens Lake is an off stream storage that is used to supplement the Waranga Western Channel, which supplies water to the Rochester and Pyramid Hill-Boort irrigation area. The Lake either receives or supplies water to the Channel via two pipelines depending on irrigation demand. Therefore, the water level in the Lake can fluctuate throughout the year between near full and near empty. Greens Lake is currently 44% full and is expected to retain water under the four inflow scenarios.

Tahbilk Lagoon is located on the Goulburn River and is part of the Goulburn Weir Pool. The water level in Tahbilk Lagoon is therefore influenced by the operation of the Goulburn Weir. The Goulburn Weir was constructed in 1890 and raises the level of the Goulburn River so that water can be diverted by gravity along a number of off-take channels to surrounding irrigation areas. The water level in the Goulburn Weir is maintained close to its full supply level throughout the year, but may be drawn down on occasion for maintenance work. Goulburn Weir is currently 98% full and under the worst inflow scenarios it may be drawn down to 90%. Tahbilk Lagoon is approximately 95% full and is expected to be maintained close to this level under the four inflow scenarios.

#### 3.3.2 Environmental Conditions

Of the 33 wetlands that support or provide refuge for priority ecological values only Reedy Swamp, Greens Lake, Cornella Creek and Tahbilk Lagoon currently hold water (Table 16). These wetlands are the only wetlands likely to hold water in the 2009-2010 season under the four inflow scenarios. Greens Lake, Cornella Creek and Tahbilk Lagoon are permanent water bodies, and therefore provide a limited range of aquatic habitats. Reedy Swamp is an ephemeral wetland and is an important colonial waterbird breeding site. Reedy Swamp has received approximately 1000 ML of environmental water since April last year, which has provided significant drought refuge for thousands of waterbirds including the threatened White-bellied Sea-Eagle, Freckled Duck and Hardhead. Additional environmental water is currently being secured for the wetland to provide ongoing drought refuge for the Catchment and potentially stimulate a large colonial bird breeding event. The remaining dry wetlands provide limited or no habitat for aquatic dependent flora and fauna. Many of these wetlands have not been flooded for a number of years as a result of river regulation, land forming and below average rainfalls, restricting the recruitment and development of aquatic dependent flora and fauna. Without appropriate flooding, some of these aquatic dependent flora and fauna species may become locally extinct.

Table 16 Current and likely environmental condition under the four inflow scenarios of the wetlands that support or provide refuge for priority ecological values.

Wetland & Status	Environmental Condition					Year last Flooded	Natural Flooding Frequency
	Current	2006/2007 Inflow	99%ile Inflow	95%ile Inflow	90%ile Inflow		
Barmah Forest	Dry <sup>1</sup>	Dry	Dry	Dry	Dry	2005 <sup>1</sup>	Near annual
Black Swamp	Dry	Dry	Dry	Dry	Dry	2008	Near annual
Boosey Creek Wetland	Dry	Dry	Dry	Dry	Dry	TBD	Near annual
Brays Swamp	Dry	Dry	Dry	Dry	Dry	2005	Near annual
Broken Creek Wetland	Dry	Dry	Dry	Dry	Dry	TBD	Near annual
Cemetery Bend	Dry	Dry	Dry	Dry	Dry	TBD	Near annual
Cornella Creek Wetland	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	NA	Permanent
Corop Swamp	Dry	Dry	Dry	Dry	Dry	TBD	Near annual
Cussen Park	Dry	Dry	Dry	Dry	Dry	2008	Semi permanent
Doctors Swamp	Dry	Dry	Dry	Dry	Dry	2008	Near annual
Gaynor Swamp	Dry	Dry	Dry	Dry	Dry	1993	Near annual

Table 16 (continued).

Wetland & Status	Environmental Condition					Year last Flooded	Required Flooding Frequency
	Current	2006/2007 Inflow	99%ile Inflow	95%ile Inflow	90%ile Inflow		
Gemmills Swamp	Dry	Dry	Dry	Dry	Dry	2005	Near annual
Goose Swamp	Dry	Dry	Dry	Dry	Dry	2005	Near annual
Greens Lake <sup>2</sup>	44% of FSL	40% of FSL	40% of FSL	40% of FSL	40% of FSL	NA	Permanent
Greens Swamp	Dry	Dry	Dry	Dry	Dry	1993	Near annual
Horse-shoe Lake	Dry	Dry	Dry	Dry	Dry	TBD	Near annual
Kanyapella Basin	Dry	Dry	Dry	Dry	Dry	1993	Near annual
Kinnairds Swamp	Dry	Dry	Dry	Dry	Dry	2008 <sup>3</sup>	Near annual
Lake Stewart	Dry	Dry	Dry	Dry	Dry	TBD	Semi permanent
Loch Garry	Dry	Dry	Dry	Dry	Dry	1996	Near annual
Mansfield Swamp	Dry	Dry	Dry	Dry	Dry	1993	Near annual
Moodies Swamp	Dry	Dry	Dry	Dry	Dry	2008 <sup>4</sup>	Near annual
Muckatah Depression	Dry	Dry	Dry	Dry	Dry	TBD	Near annual
Murray Road Wetland	Dry	Dry	Dry	Dry	Dry	TBD	Near annual
One Tree Swamp	Dry	Dry	Dry	Dry	Dry	2003	Near annual
Reedy Swamp	30% of FSL	Dry by summer	Dry by summer	Dry by summer	Dry by summer	2008	Near annual
Ross Swamp	Dry	Dry	Dry	Dry	Dry	TBD	Near annual
Stockyard Plain	Dry	Dry	Dry	Dry	Dry	TBD	Near annual
Tahbilk Lagoon	Full	Full	Full	Full	Full	NA	Permanent
Timmering Depression	Dry	Dry	Dry	Dry	Dry	TBD	Near annual
Two Tree Swamp	Dry	Dry	Dry	Dry	Dry	2003	Near annual
Wallenjoe Wetlands	Dry	Dry	Dry	Dry	Dry	1993	Near annual
Woolwash Swamp	Dry	Dry	Dry	Dry	Dry	TBD	Near annual

- 1 The last time Barmah was significantly flooded was in 2005. However, Gulf creek received a small volume of environmental water in 2008 and water was released into three other creeks in 2009 after a number of regulators were vandalised.
- 2 Greens Lake is an off stream storage and its water level fluctuates throughout the year depending on irrigation demand. However, on average it holds approximately 40% of its FSL.
- 3 Received 413 ML of environmental water between April and June 2008 which partially filled the wetland.
- 4 Surplus irrigation flows in the Broken Creek were opportunistically diverted to Moodies Swamp in 2008, which inundated approximately half the wetland. The wetland was last filled in 1996.

## 4.0 Risk Management Priorities

To help establish management priorities, the likelihood and consequence of the major threat types (habitat loss and reduced water quality) (Appendix 3), impacting on priority ecological values under the four inflow scenarios has been rated as either high, medium or low according to set criteria for each stream and wetland that supports or provides refuge for priority ecological values (Table 17). However, waterbirds are particularly mobile. Therefore, the likelihood and consequence of the major threat types impacting on them under the four inflow scenarios has been considered separately at a catchment scale rather than at the individual wetland and stream reach scale (Section 4.3).

Judgements concerning the likelihood and consequence of the risk impacting on an environmental value have been made in the absence of complete information and agreement or disagreement with the criteria was made on the basis of a best estimate of the parameter. High, medium and low management priorities have then been determined according to the impact rating score and the priority assigned to the environmental value (Table 18). Tables 19-22 list the priority values within each stream and wetland where appropriate, and the assigned impact rating score and risk management priority (colour coded). The analysis indicates that the priority ecological values under most threat from the impacts of habitat loss and reduced water quality are primarily native fish and water birds. The native fish species under most threat are Barred Galaxias, Macquarie Perch, Murray Cod, Trout Cod, Dwarf Flat-headed Gudgeon, Southern Pygmy Perch and Silver Perch in the Broken Creek, Broken River, a number of unregulated streams and Barmah Forest. The waterbirds under most threat are Brolga, Great Egret, Little Egret, Intermediate Egret, Whiskered Tern and Gull-bill Tern.

Table 17 Impact rating criteria.

Impact Rating	Criteria
High	Likely to decrease the population to a level that threatens its viability
	Likely to have a significant impact on the ecological features and functions of the reach
Medium	May decrease the population to a level that threatens its viability
	May have a significant impact on the ecological features and functions of the reach
Low	Unlikely to decrease the population to a level that threatens its viability
	Unlikely to have a significant impact on the ecological features and functions of the reach

Table 10 Risk management priority criteria.

Risk Impact Rating	Ecological Value Priority		
	High	Medium	Low
High	High	High	Medium
Medium	High	Medium	Low
Low	Medium	Low	Low

### Risk Management Priority

Risk management priority:

	High
	Medium
	Low

## 4.1 Regulated Streams

Table 19 below lists the priority values supported by regulated streams, and their assigned impact rating score and risk management priority under the four inflow scenarios.

Table 19 Risk management priorities for regulated streams.

Stream	Reach	Ecological Value	Priority	2006/2007 Inflow		99%ile Inflow		95%ile Inflow		90%ile Inflow	
				Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss
Boosey Creek	32	Coolibah Grass	Low	Low	Low	Low	Low	Low	Low	Low	Low
	34	Growling Grass Frog	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	TBD	Pepper Grass	Low	Low	Low	Low	Low	Low	Low	Low	Low
	34	Slender Club-sedge	Medium	Low	Medium	Low	Medium	Low	Medium	Low	Medium
	32	Amulla	Low	Low	Low	Low	Low	Low	Low	Low	Low
Broken Creek	24	Golden Perch	Medium	High	High	High	High	High	High	High	High
	21 - 23	Murray Cod	Medium	High	High	High	High	High	High	High	High
	22	Ridged Water-milfoil	Medium	Low	Medium	Low	Medium	Low	Medium	Low	Medium
	24	Slender Water-milfoil	Low	Low	Medium	Low	Medium	Low	Medium	Low	Medium
	TBD	Striped Water-milfoil	Medium	Low	Medium	Low	Medium	Low	Medium	Low	Medium
	24	Yellow-tongue Daisy	Medium	Low	Low	Low	Low	Low	Low	Low	Low
Broken River	1-4	Golden Perch	Medium	High	High	High	High	High	High	High	High
	1-5	Murray- Darling rainbowfish	Low	High	High	High	High	High	High	High	High
	3 - 5	Macquarie Perch	High	High	High	High	High	High	High	High	High
	1-5	Murray Cod	Medium	High	High	High	High	High	High	High	High
	1	Silver Perch	Medium	High	High	High	High	High	High	High	High
	1-4	Trout Cod	High	High	High	High	High	High	High	High	High
Goulburn River	4, 12	Brown Toadlet	Low	Low	Low	Low	Low	Low	Low	Low	Low
	1, 4, 6	Growling Grass Frog	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	1 - 8	Murray Cod	Medium	Medium	Medium	Medium	Medium	Low	Low	Low	Low
	6	River Swamp Wallaby-grass	Low	Low	Low	Low	Low	Low	Low	Low	Low
	1 - 8	Silver Perch	Medium	Medium	Medium	Medium	Medium	Low	Low	Low	Low
	9	Water-shield	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	3	Western Water-starwort	Low	Low	Low	Low	Low	Low	Low	Low	Low
Nine Mile Creek	29	Grey Billy-buttons	Low	Low	Low	Low	Low	Low	Low	Low	Low

## 4.2 Unregulated Streams

Table 20 below lists the priority values supported by unregulated streams, and their assigned impact rating score and risk management priority under the four inflow scenarios.

Table 20 Risk management priorities for unregulated streams.

Stream	Reach	Ecological Value	Priority	2006/2007 Inflow		99%ile Inflow		95%ile Inflow		90%ile Inflow	
				Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss
Acheron River	63	Brown Toadlet	Low	High	Low	High	Low	High	Low	High	Low
	63	Murray Spiny Cray	Low	High	Low	High	Low	High	Low	High	Low
Big River	68	Ecolog. healthy river	High	Low	Low	Low	Low	Low	Low	Low	Low
	67	Spotted Tree Frog	High	Medium	Low	Medium	Low	Medium	Low	Medium	Low
Delatite River	71	Murray Cod	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	72	Stonefly	Medium	Low	Low	Low	Low	Low	Low	Low	Low
Goulburn River	16	Barred Galaxias	High	Low	Low	Low	Low	Low	Low	Low	Low
	15	Ecolog. healthy river	High	Low	Low	Low	Low	Low	Low	Low	Low
	15	Macquarie Perch	High	Low	Low	Low	Low	Low	Low	Low	Low
	16	Spotted Tree Frog	High	Low	Low	Low	Low	Low	Low	Low	Low
Holland Creek	14	Brown Toadlet	Low	Medium	Medium	Low	Low	Low	Low	Low	Low
	14	Dookie Daisy	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	13-14	Macquarie Perch	High	High	High	Low	Low	Low	Low	Low	Low
Howqua River	70	Spotted Tree Frog	High	Low	Low	Low	Low	Low	Low	Low	Low
Hughes Creek <sup>1</sup>	37	Macquarie Perch	High	High	High	Low	Low	Low	Low	Low	Low
	37	Murray Cod	Medium	High	High	Low	Low	Low	Low	Low	Low
King Parrot Creek <sup>1</sup>	51	Macquarie Perch	High	High	High	High	Low	High	Low	High	Low
Leary's Creek <sup>1</sup>	NA	Barred Galaxias	High	High	Low	High	Low	High	Low	High	Low
Rubicon River <sup>1</sup>	66	Barred Galaxias	High	High	Low	High	Low	High	Low	High	Low
Ryans Creek	17	Ecolog. healthy river	High	Low	Low	Low	Low	Low	Low	Low	Low
	16-17	Growling Grass Frog	Medium	Low	Low	Low	Low	Low	Low	Low	Low
Seven Creeks	19-20	Macquarie Perch	High	High	High	Low	Low	Low	Low	Low	Low
	20	Murray Spiny Cray	Low	High	High	Low	Low	Low	Low	Low	Low
	19	Trout Cod	High	High	High	Low	Low	Low	Low	Low	Low
Steavenson River <sup>1</sup>	NA	Barred Galaxias	High	High	Low	High	Low	High	Low	High	Low
Sunday Creek <sup>1</sup>	NA	Barred Galaxias	High	High	High	High	Low	High	Low	High	Low
Taggerty River <sup>1</sup>	64	Barred Galaxias	High	High	Low	High	Low	High	Low	High	Low
	64	Ecolog. healthy river	High	Low	Low	Low	Low	Low	Low	Low	Low
	64	Growling Grass Frog	Medium	High	Low	High	Low	High	Low	High	Low
Yea River	54	Damselfly	Medium	Medium	Low	Medium	Low	Medium	Low	Medium	Low
	55	Macquarie Perch	High	Medium	Low	Medium	Low	Medium	Low	Medium	Low

<sup>1</sup> A number of Barred Galaxias and Macquarie Perch have been removed from these streams (see Table x) reducing the overall risk to these values. However, the Barred Galaxias and Macquarie Perch that remain are still at significant risk and if they are lost it will reduce the future capacity of these species to persist in these streams.

### 4.3 Wetlands

Table 21 below lists the priority values supported by wetlands, and their assigned impact rating score and the risk management priority under the four inflow scenarios.

Table 21 Risk management priorities for wetlands.

Wetland	Ecological Value	Priority	2006/2007 Inflow		99%ile Inflow		95%ile Inflow		90%ile Inflow	
			Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss
Barmah Forest	Barking Marsh Frog	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Broad-shelled Turtle	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Brown Toadlet	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Button Rush	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Common Long-necked Turtle	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Common Spadefoot Toad	Low	High	High	High	High	High	High	High	High
	Downs Nutgrass	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Dwarf Flat-headed Gudgeon	High	High	High	High	High	High	High	High	High
	Flat-headed Galaxias	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Freshwater Catfish	Medium	High	High	High	High	High	High	High	High
	Giant Bullfrog	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Golden Perch	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	Growling Grass Frog	Medium	High	High	High	High	High	High	High	High
	Macquarie Perch	High	Low	Low	Low	Low	Low	Low	Low	Low
	Moir Grass	Low	High	High	High	High	High	High	High	High
	Mueller Daisy	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Murray Cod	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	Murray- Darling Rainbowfish	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Murray Spiny Cray	Low	Low	Low	Low	Low	Low	Low	Low	Low
	River Blackfish	Low	High	High	High	High	High	High	High	High
	River Swamp Wallaby-grass	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Silver Perch	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	Sloane's Froglet	Low	High	High	High	High	High	High	High	High
	Southern Pygmy Perch	High	High	High	High	High	High	High	High	High
	Swamp Yabby	Low	High	High	High	High	High	High	High	High
	Trout Cod	High	Low	Low	Low	Low	Low	Low	Low	Low
	Yellow-tongue Daisy	Medium	Low	Low	Low	Low	Low	Low	Low	Low
Black Swamp	River Swamp Wallaby-grass	Low	Low	Low	Low	Low	Low	Low	Low	Low
Boosey Creek Wetland	Swamp Star	Low	Low	Low	Low	Low	Low	Low	Low	Low
Gaynor Swamp	Salt Paperbark	Medium	Low	Low	Low	Low	Low	Low	Low	Low

Table 21 (continued).

Wetland	Ecological Value	Priority	2006/2007 Inflow		99%ile Inflow		95%ile Inflow		90%ile Inflow	
			Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss
Greens Swamp	Ridged Water-milfoil	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Western Water-starwort	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Kanyapella Basin	River Swamp Wallaby-grass	Low	Low	Low	Low	Low	Low	Low	Low	Low
Kinnairds Swamp	Ridged Water-milfoil	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	Slender Water-milfoil	Low	Low	Low	Low	Low	Low	Low	Low	Low
Mansfield Swamp	Cane Grass	Low	Low	Low	Low	Low	Low	Low	Low	Low
Moodies Swamp	Ridged Water-milfoil	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	Slender Water-milfoil	Low	Low	Low	Low	Low	Low	Low	Low	Low
Tahbilk Lagoon	Broad-shelled Turtle	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Freshwater Catfish	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	Murray- Darling Rainbowfish	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	Water-shield	Medium	Low	Low	Low	Low	Low	Low	Low	Low
Timmering Depression	Cane Grass	Low	Low	Low	Low	Low	Low	Low	Low	Low
Wallenjo Wetlands	Cane Grass	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Salt Paperbark	Medium	Low	Low	Low	Low	Low	Low	Low	Low

### 4.3 Waterbirds

Waterbird abundance, breeding and habitat have significantly declined across Victoria and much of the Murray-Darling Basin in response to the prolonged dry conditions (Birds Australia 2008; Porter et al. 2006). Of the priority waterbirds identified in the Plan the following are considered to be at greatest risk in the Goulburn Broken Catchment from no or low inflows in 2009-2010 due to their small populations, and limited distribution and capacity for broad continental movement (Table 22) (DSE FFG Actions Statement Great, Intermediate and Little Egret; DSE FFG Actions Statement Brolga):

- Australasian Bittern;
- Brolga;
- Eastern Great Egret;
- Gull-bill Tern;
- Intermediate Egret;
- Little Egret; and
- Painted Snipe.

The Brolga may be particularly vulnerable to local extinction due to its very small population (60-70 birds) and small clutch size (1-2 eggs). Without sufficient recruitment to replace the aging population the number of birds may drop below sustainable levels when older birds die (DSE FFG Actions Statement Brolga).

Table 22 Risk management priorities for waterbirds.

Waterbird	Priority	2006/2007 Inflow		99%ile Inflow		95%ile Inflow		90%ile Inflow	
		Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss	Reduced Water Quality	Habitat Loss
Australasian Bittern	Medium	Medium	High	Medium	High	Medium	High	Medium	High
Australasian Shoveler	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Australian Little Bittern	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Baillon's Crake	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Blue-billed Duck	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Brolga	High	Medium	High	Medium	High	Medium	High	Medium	High
Caspian Tern	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Eastern Great Egret	Medium	Medium	High	Medium	High	Medium	High	Medium	High
Freckled Duck	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Gull-billed Tern	Medium	Medium	High	Medium	High	Medium	High	Medium	High
Hardhead	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Intermediate Egret	Medium	Medium	High	Medium	High	Medium	High	Medium	High
Lewin's Rail	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Little Egret	Medium	Medium	High	Medium	High	Medium	High	Medium	High
Magpie Goose	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Musk Duck	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Painted Snipe	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Royal Spoonbill	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
White-bellied Sea-Eagle	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Wood Sandpiper	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium



## 5.0 Management Actions

The following 46 actions address the management objectives and the risk management priorities at a total cost of approximately \$815,000. The actions include:

- Regulating flows to maintain or improve aquatic habitat.
- Enforcing or amending existing rules for water extraction to maintain or improve aquatic habitat.
- Monitoring water quality and native fish populations, this can trigger actions such as the relocation of native fish or flow regulation. Monitoring water quality and native fish populations can also improve our understanding on how they respond to dry inflows, which will inform the development of future low inflow management actions.
- Controlling exotic fish biomass to reduce competition with native fish species.
- Fencing out or removing stock from riparian and wetland habitats to reduce grazing pressure on native vegetation, maintain fauna habitat and reduce nutrient and sediment inputs.
- Controlling pest plants to reduce competition with native flora species and maintain or improve fauna habitat.
- Protecting and increasing drought refuge.

Actions for regulated streams, unregulated streams, wetlands and waterbirds are grouped under corresponding headings and flow scenarios. For each action the corresponding management objective (section 1.3), purpose, ecological values targeted, required consultation, timing, estimated, cost, funding source and priority (High, Medium and Low) are identified. Actions are only identified for streams and wetlands where they are considered necessary or feasible. Definitions of the three priority ratings are as follows:

High: Actions that contribute to the mitigation of high risk management priorities; or contribute to the maintenance or enhancement of high priority ecological values.  
Medium: Actions that contribute to the mitigation of medium risk management priorities; or contribute to the maintenance or enhancement of medium priority ecological values.  
Low: Actions that contribute to the mitigation of low risk management priorities; or contribute to the maintenance or enhancement of low priority ecological values; or contribute to the maintenance or enhancement of the ecological values and functions of priority streams and wetlands.

### 5.1 Actions for Regulated Streams

Goulburn River (2006/2007 and 99% Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
1	Goulburn Weir - Murray River (reaches 1-8)	i, ii, iii, v, vi	Run 150 ML/day from July to October and 250 ML/ day from November to June if the irrigation allocation is zero. If the irrigation allocation is 1% continue to run the river at the above rates and save the water that could be passed down the river for water quality management. At 1% irrigation allocation 220 ML/day from July to October and 300 ML/ day from November to June may be passed down the river.	Maintain aquatic habitat and water quality	Murray Cod, Silver Perch	GB CMA Board, G-MW, DSE	June 2009	NA	NA	High

## Goulburn River (All Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
2	Goulburn Weir - Murray River (reaches 1-8)	i, ii, iii, v, vi	Monitor water quality and flow.	Inform management decisions	Murray Cod, Silver Perch	G-MW, DSE	Ongoing	NA	7GL	High
3	Goulburn Weir - Murray River (reaches 1-8)	i, ii, iii, v, vi	Utilise the 20 GL Goulburn Water Quality allowance to manage water quality as required.	Maintain aquatic habitat and water quality	Murray Cod, Silver Perch	GB CMA Board, G-MW, DSE	Ongoing	NA	NA	High
4	Eildon - Murray River (reaches 1-14)	i, ii, iii, v, vi	Look for opportunities to utilise inter valley water transfers to gain environmental benefits.	Maintain aquatic habitat and water quality	Murray Cod, Silver Perch	G-MW, DSE	Ongoing	NA	NA	High
5	Eildon - Goulburn Weir (reaches 10-11)	i, ii, iii, v, vi	Monitor water quality (particularly turbidity). Develop management responses (decision tree) to high turbidity as a result of sediment and ash washing into the stream from the fire affected area.	Maintain aquatic habitat and water quality	Murray Cod, Silver Perch	G-MW, DSE, EPA, GVV	Ongoing	NA	NA	High
6	Goulburn Weir - Murray River (reaches 1-8)	i, ii, iii, v	Survey fish and macroinvertebrate communities (abundance and diversity) and riparian and in-channel vegetation condition.	Inform management decisions	Murray Cod, Silver Perch, general ecological values and functions	G-MW, DSE	Spring & autumn 2009-2010	\$78,000	VEFMAP	Medium
7	Goulburn Weir - Murray River (reaches 1-8)	i, ii, iii, v	Survey the abundance and diversity of fish, fish eggs and fish larvae (ARI implementing).	Inform management decisions	Murray Cod, Silver Perch	G-MW, DSE	Spring & autumn 2009-2010	\$76,000	Goulburn LSRR	Medium
8	Goulburn Weir	i, ii, iii, v, vi	Monitor water quality and flow (G-MW implementing).	Inform management decisions	Murray Cod, Silver Perch	GB CMA	Ongoing	NA	NA	Medium

## Broken River (All Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
9	Lake Nillahcootie - Goulburn River (reaches 1-5)	i, ii, iii, v, vi	Monitor water quality and flow (G-MW implementing).	Inform management decisions	Murray Cod, Silver Perch, Trout Cod, Macquarie Perch, Murray-Darling Rainbowfish	GB CMA	Ongoing	NA	NA	High
10	Caseys Weir - Goulburn River (reaches 1-2)	i, ii, iii, v, vi, vii	ARI to develop a translocation strategy for threatened fish populations in the lower Broken Creek.	Avoid local extinction of population	Murray Cod, Silver Perch, Trout Cod, Macquarie Perch, Murray-Darling Rainbowfish, general ecological values and functions	GB CMA, DSE, G-MW	Winter 2009	TBD	TBD	High

Broken River (All Inflow Scenarios continued)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
11	Caseys Weir - Goulburn River (reaches 1-2)	i, ii, iii, v, vi, vii	G-MW to identify water volumes held in weir pools to determine their aquatic refuge value and monitor their decline over summer.	Inform management decisions	Murray Cod, Silver Perch, Trout Cod, Macquarie Perch, Murray-Darling Rainbowfish, general ecological values and functions	GB CMA , DSE	Winter to autumn 2009-2010	NA	NA	High
12	Benalla - Lake Nillahcootie (reaches 3-5)	i, ii, iii, v	Survey the Macquarie Perch population to determine its status and extent (ARI implementing).	Inform management decisions	Macquarie Perch	G-MW , DSE	Spring & autumn 2009-2010	\$15,000	RCIP	High
13	Caseys Weir - Goulburn River (reaches 1-2)	i, ii, iii, v, vi, vii	Survey fish and macroinvertebrate communities (abundance and diversity) and riparian and in-channel vegetation condition.	Inform management decisions	Murray Cod, Silver Perch, Trout Cod, Macquarie Perch, Murray-Darling Rainbowfish, general ecological values and functions	G-MW , DSE	Spring & autumn 2009-2010	\$39,000	VEFMAP	High

Broken and Boosey Creeks (All Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
14	Broken Creek Nathalia to the Murray River (reaches 21-23)	i, ii, iii, v, vi, vii	Divert Murray River flows down the lower Broken Creek where available. If Murray River water is unavailable, divert Goulburn River water down the lower Broken Creek where available. Utilise the 20 GL Goulburn River Water Quality allocation (if not required by the Goulburn River) to provide supplementary flows down the lower Broken Creek if it receives flows from the Murray or Goulburn Rivers.	Maintain aquatic habitat and water quality	Murray Cod	G-MW, DSE	Spring & summer 2009-2010	NA	NA	High
15	Broken Creek Nathalia (reaches 23)	i, ii, iii, v, vii	G-VW to maintain Nathalia weir pool to supply township.	Maintain aquatic habitat and water quality	General aquatic dependent species	G-MW, DSE	Ongoing	NA	NA	High
16	Broken Creek Nathalia to the Murray River (reaches 21-23)	i, ii, iii, v, vi, vii	Look for opportunities to utilise inter valley water transfers to maintain aquatic habitat.	Maintain aquatic habitat and water quality	Murray Cod	G-MW, DSE	Spring & summer 2009-2010	NA	NA	High

Broken and Boosey Creeks (All Inflow Scenarios continued)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
17	Broken Creek Nathalia to the Murray River (reaches 21-23)	i, ii, iii, v, vi, vii	If Murray and Goulburn River flows are unavailable, successively draw down the weir pools to maintain aquatic habitat in as many of the weir pools as possible.	Maintain aquatic habitat and water quality	Murray Cod	ARI, G-MW, DSE	Spring & summer 2009-2010	NA	NA	High
18	Broken Creek Nathalia to the Murray River (reaches 21-23)	i, ii, iii, v, vi, vii	ARI to develop a fish translocation strategy for the lower Broken Creek in conjunction with the proposed successive draw down of the weir pools.	Maintain aquatic habitat and water quality	Murray Cod	GB CMA, G-MW, DSE	Winter 2009	TBD	TBD	High
19	Broken Creek Rices Weir (reach 21)	i, ii, iii, v, vi, vii	Continue to monitor water quality, weather and Azolla in Rices Weir pool.	Inform management decisions	Murray Cod	G-MW, DSE	Spring & summer 2009-2010	NA	NA	High
20	Broken Creek (reaches 21-27)	i, ii, iii, v, vi, vii	Survey fish and macroinvertebrate communities (abundance and diversity) and riparian and in-channel vegetation condition.	Inform management decisions	Murray Cod, general ecological values and functions	G-MW, DSE	Spring & autumn 2009-2010	\$39,000	VEFMAP	High
21	Boosey Creek Katamatite - Tungamah (reach 33)	i, ii, iii, v, vii	Create, enhance and re-snap exiting habitat pools in the Boosey Creek.	Maintain aquatic habitat and water quality	General aquatic dependent species	G-MW, DSE	May 2009	\$24,000	Moir Shire, Broken LSRR, Tungamah Fish Club	Medium
22	Boosey Creek Tungamah (reach 33)	i, ii, iii, v, vii	Moir Shire to fill Tungamah weir pool.	Maintain aquatic habitat and water quality	General aquatic dependent species	GB CMA, G-MW, DSE	May 2009	NA	Moir Shire	Medium
23	Broken Creek Katamatite - Waggarandall Weir (reaches 25-26)	i, ii, iii, v, vii	Deepen 6 exiting habitat pools in the Broken Creek.	Maintain aquatic habitat and water quality	General aquatic dependent species	G-MW, DSE	August 2009	\$60,000	Broken LSRR	Medium
24	Broken Creek Katamatite - Waggarandall Weir (reaches 25-26)	i, ii, iii, v, vii	Monitor water quality in the deepened pools on the Broken Creek (includes the installation of water quality probes).	Inform management decisions	General aquatic dependent species	G-MW, DSE	Spring & summer 2009-2010	\$72,600	VEFMAP	Medium

## 5.2 Actions for Unregulated Streams

### Unregulated Streams (All Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
25	Holland Creek and Sunday Creek	i, ii, iii, v, vii	Continue to enforce irrigation suspensions until flow conditions improve.	Maintain aquatic habitat and water quality	Barred Galaxias, Macquarie Perch, and Brown Toadlet.	G-MW	Ongoing	NA	NA	High
26	Goulburn River, Holland Creek, Howqua River, Hughes Creek, King Parrot Creek, Rubicon River, Sunday Creek, Seven Creeks, Steavenson River and Yea River	i, ii, iii, v, vii	G-MW to enforce existing irrigation restriction and suspension rules.	Maintain aquatic habitat and water quality	Barred Galaxias, Macquarie Perch, Spotted Tree Frog, Trout Cod, Brown Toadlet, Murray Spiny Cray, Murray Cod and Ecologically Healthy River.	GB CMA, DSE	Ongoing	NA	NA	High
27	Delatite River, King Parrot Creek, Ryans Creek, Seven Creeks and Yea River	i, ii, iii, iv, v, vii	Maintain existing urban passing flows.	Maintain aquatic habitat and water quality	Ecologically Healthy River, Growling Grass Frog, Macquarie Perch	GVW, Melbourne Water, North East Water	Ongoing	NA	NA	High
28	Seven Creeks (reach 19)	i, ii, iii, v, vii	Continue urban winter extraction directly from the Creek into Abbinger Reservoir in reach 17 to minimise impacts on Trout Cod habitat (reach 19).	Maintain aquatic habitat and water quality	Macquarie Perch, Trout Cod	GVW	Winter 2009	NA	NA	High
29	Holland Creek, Hughes Creek, King Parrot Creek, Leary's Creek, Seven Creeks, Delatite River, Goulburn River, Rubicon River, Taggerty River, Steavenson River, Yea River and Sunday Creek	i, ii, iii, iv, v, vii	Establish risk management protocols for fish populations in drought affected streams.	Inform management decisions	Macquarie Perch, Murray Cod, Barred Galaxias, Trout Cod	DPI Fisheries, ARI, DSE	Winter 2009	\$10,000	RCIP	High
30	Seven Creeks	i, ii, iii, v, vii	ARI to survey the Trout Cod population to determine its abundance and distribution. Assess the condition of its habitat.	Inform management decisions	Trout Cod	DSE, GB CMA	Spring & autumn 2009-2010	\$25,000	RCIP	High
31	King Parrot Creek	i, ii, iii, v, vii	ARI to survey the Macquarie Perch population to determine its abundance and distribution. Assess the condition of its habitat.	Inform management decisions	Macquarie Perch	DSE, GB CMA	Spring & autumn 2009-2010	\$10,000	RCIP	High

Unregulated Streams (All Inflow Scenarios continued)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
32	Hughes Creek	i, ii, iii, v, vii	ARI to survey the Macquarie Perch population to determine its abundance and distribution. Assess the condition of its habitat. Install signs at key access points to inform the public that the protected species is found in these waters.	Inform management decisions	Macquarie Perch	DSE, GB CMA	Spring & autumn 2009-2010	\$12,000	RCIP	High
33	Acheron River, Big River, Dry Creek, Goulburn River, King Parrot Creek, Murrindindi River, Rubicon River, Snobs Creek, Sunday Creek and Yea River	i, ii, iii, v, vi, vii	Monitor water quality and macroinvertebrates in waterways recently affected by fire (Waterwatch implementing - Ash Watch Program).	Inform management decisions	Spotted Tree Frog, Macquarie Perch, Barred Galaxias, Ecologically Healthy River, Growling Grass Frog	GB CMA, G-MW, GVV, Melbourne Water, North East Water, DSE	2009-2010	TBD	Fire recovery	Medium

### 5.3 Actions for Wetlands and Waterbirds

Wetlands and Waterbirds (All Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
34	Barmah Forest (All of the forest)	i, ii, v, vii	Continue to prohibit stock grazing while biomass is low (DSE and PV implementing).	Reduce grazing pressure and maintain aquatic habitat	Moir Grass, Growling Grass Frog	GB CMA	Ongoing	NA	NA	High
35	Barmah Forest	i, ii, v, vii	Deliver environmental water (up to 1 GL) to the following priority areas: Top Island; Boals Deadwoods; Goose Swamp; Gulf Creek; Smiths Creek; Steamer Plain; and War Plain.	Maintain aquatic habitat	Colonial-nesting waterbird habitat, native vegetation, Southern Pygmy Perch, Dwarf Flat-headed Gudgeon and turtles	DSE, PV	Spring & summer 2009-2010	NA	NA	High
36	Barmah Forest	i, ii, v, vii	Monitor the ecological response of Barmah Forest to the application of environmental water.	Inform management decisions	Waterbirds, vegetation and fish	DSE, PV	Spring & summer 2009-2010	TBD	TLM	High
37	Wetlands	i, ii, v, vii	Seek additional environmental water to inundate key wetlands in the Catchment, including Cane Grass dominated wetlands.	Maintain aquatic habitat	Waterbird habitat (including habitat for colonial nesting species and Brolga), drought refuge	DSE, PV, DPI	Winter 2009	NA	NA	High

## Wetlands and Waterbirds (All Inflow Scenarios continued)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
38	Moodies Swamp	i, ii, v, vii	Carry out minor channel works to improve flow efficiency. Capture opportunistic flows (surplus irrigation flows or catchment runoff).	Maintain aquatic habitat	Waterbird habitat (including Brolga habitat), Ridged Water-milfoil, drought refuge	DSE, PV, G-MW	Winter 2009	\$5,000	RCIP	High
39	Reedy Swamp	i, ii, v, viii	Deliver up to an additional 500 ML to Reedy Swamp to maintain aquatic habitat and support bird breeding events.	Maintain aquatic habitat	Waterbird habitat (including habitat for colonial nesting species), drought refuge	DSE, PV, G-MW	Spring & summer 2009-2010	NA	NA	High
40	Reedy Swamp	i, ii, v, viii	Continue to monitor the ecological response of Reedy Swamp to the application of environmental water.	Inform management decisions	Waterbirds	GB CMA, DSE, PV, DPI	Ongoing	NA	NA	High

## 5.4 Complimentary Actions

## All Inflow Scenarios

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
41	Selected unregulated and regulated streams	all	Fence riparian vegetation along stream reaches which support or provide refuge for priority ecological values to reduce stock grazing pressure.	Protect riparian and instream habitat and maintain water quality	A number of priority ecological values	DSE, DPI	2009-2010	\$200,000	RCIP/Fire Recovery	High
42	Unregulated streams affected by the recent fires	i, ii, iii, iv	Continue to support fire recovery planning and the development of a fire recovery plan.	Protect riparian and instream habitat and maintain water quality	Macquarie Perch, Murray Cod, Trout Cod, Barred Galaxias	DHS, DSE, DPI	Ongoing	NA	NA	High
43	Selected unregulated and regulated streams	all	Control aquatic and riparian weed infestations.	Protect riparian and instream habitat and maintain water quality	A number of priority ecological values	DSE, DPI, G-MW	2009-2010	\$100,000	RCIP/Fire Recovery	High
44	Broken River, Goulburn Weir, Lake Banella	vi, vii	Investigate Cabomba management techniques.	Inform management decisions	General stream ecological values and functions	DSE, G-MW	2008-2009	\$50,000	DWM	Medium
45	Boosey Creek (reach 32)	i	Monitor the condition and abundance of the Amulla population.	Inform management decisions	Amulla	PV	Spring & summer 2009-2010	NA	NA	Low
46	Goulburn Weir	i, v, vii	Reduce Yellow Water-Lily infestations	Reduce competition with native flora and maintain aquatic habitat	Water-shield	G-MW	Ongoing	TBD	G-MW	Low

## 5.5 Action Summary

Below is a summary of the key actions outlined in 5.1-5.4 for regulated streams, unregulated streams, wetlands and waterbirds.

Location	Key Actions	2006 2007	99%ile	95%ile	90%ile
Goulburn River	• Regulate flows (150 ML/d July-Oct 250 ML/d Nov-Jun)	√	√		
	• Regulate flows (if 1% irrigation allocation run flows as above and use saved water for managing water quality)	√	√		
	• Monitor water quality	√	√	√	√
	• Manage water quality with the 20 GL Goulburn Water Quality Allowance	√	√	√	√
	• Utilise IVT where possible	√	√	√	√
	• Monitor ecological values (fish, vegetation and macroinvertebrates)	√	√	√	√
	• Develop a fish translocation strategy	√	√	√	√
Broken River	• Monitor water quality	√	√	√	√
	• Monitor aquatic habitat in weir pools	√	√	√	√
	• Monitor ecological values (fish, vegetation and macroinvertebrates)	√	√	√	√
	• Develop a fish translocation strategy	√	√	√	√
Broken and Boosey Creeks	• Divert Murray River flows down the lower Broken Creek where available	√	√	√	√
	• Utilise the 20 GL Goulburn Water Quality Allowance to provide supplementary flows if not required by the Goulburn River	√	√	√	√
	• Monitor ecological values (fish, vegetation and macroinvertebrates)	√	√	√	√
	• GVW to maintain the Nathalia weir pool	√	√	√	√
	• Utilise IVT where possible	√	√	√	√
	• Monitor water quality	√	√	√	√
	• Draw down weir pools in succession if Murray and Goulburn River flows are unavailable	√	√	√	√
	• Moira shire to fill Tungahmah weir pool	√	√	√	√
	• Develop a fish translocation strategy	√	√	√	√
Unregulated Streams	• Enforce irrigation restriction and suspension rules until flow conditions improve	√	√	√	√
	• Maintain existing urban passing flows	√	√	√	√
	• GVW to continue urban winter extraction from the Seven Creeks into Abbinger Reservoir	√	√	√	√
	• Survey the Trout Cod population in the Seven Creeks	√	√	√	√
	• Survey the Macquarie Perch populations in the King Parrot Creek and Hughes Creeks	√	√	√	√
	• Monitor water quality	√	√	√	√
	• Develop a fish translocation strategy	√	√	√	√



Location	Key Actions	2006 2007	99%ile	95%ile	90%ile
Wetlands and Waterbirds	<ul style="list-style-type: none"> <li>Prohibit stock grazing from Barmah Forest</li> </ul>	√	√	√	√
	<ul style="list-style-type: none"> <li>Deliver environmental water to priority areas in Barmah Forest and monitor the ecological response</li> </ul>	√	√	√	√
	<ul style="list-style-type: none"> <li>Deliver environmental water to Reedy Swamp and monitor the ecological response</li> </ul>	√	√	√	√
	<ul style="list-style-type: none"> <li>Seek environmental water to inundate other key wetlands in the Catchment</li> </ul>	√	√	√	√

## 6.0 Links

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The ongoing development and implementation of this Plan needs to be coordinated with a number of relevant processes, programs and documents including:

### Partnership Agreement for Preparedness and Response to Waterway Incidents in the GBC

The Partnership Agreement has the intention of clearly establishing the framework for leadership, and providing guidance in operations, communications and investigation of waterway incidents. This is considered essential to ensure a coordinated approach and in order to maintain the confidence of the public while all agencies carry out their respective roles in protecting, restoring and maintaining the quality of the waterways. The key agencies with regulatory or functional responsibilities for waterways in the Goulburn Broken Catchment are:

- Goulburn-Murray Water;
- Environmental Protection Authority (EPA);
- Department of Sustainability and Environment;
- Goulburn-Broken Catchment Management Authority;
- Goulburn Valley Region Water Authority;
- North East Region Water Authority;
- Department of Primary Industries; and
- Department of Human Services (DHS).

### Saving the Soil

As part of the Victorian Governments Drought Package, the Department of Sustainability and Environment (DSE) is offering financial assistance to help with the establishment of stock containment areas through the "Saving the Soil" project. This project is being delivered on behalf of DSE by the Department of Primary Industries (DPI) and in partnership with 5 Catchment Management Authorities: Mallee, Wimmera, North Central, Goulburn Broken and North East.

### Interim Fish Kill Protocol

The EPA has the responsibility under the *Environment Protection Act 1970* to investigate any events that pollute or result from pollution of Victorian waterways and may direct any necessary clean up action. Under the Emergency Management Manual of Victoria, EPA is listed as the 'control agency for pollution of inland waters'. Although the majority of fish kills would not be considered emergency incidents, for the moment EPA has accepted the response manager role for fish kills, where there are no other response plans or agreements to designate other agencies. In this regard, EPA is working with other relevant Agencies to better manage our collective response to fish kill and develop a Regional Response Structure. EPA's current role in managing fish kills is to:

- Receive notification of fish kills from agencies or the public.
- Notify other relevant agencies and stakeholders so that they may respond.
- As necessary, direct other agencies to clean up (remove dead fish from waterways) in order to protect the environment.
- Investigate fish kill incidents and determine, if possible, the cause of the fish kill.
- As appropriate, undertake enforcement action and recover costs consistent with EPA's Enforcement Policy.
- Coordinate media releases.
- As necessary, run a debrief session.

Fish kills can result from low levels of water in reservoirs or low flows in rivers and the consequent poor quality water, such as low oxygen, high temperatures or high nutrients. Fish kills may also occur with the first rains after bush fires, a blue green algal bloom, or as a result of pollution. For the purposes of the protocol a fish kill includes kills of molluscs (eg. mussels) and crustaceans (eg. yabbies & crayfish).

### Water Supply Demand Strategy

Within the region two urban water authorities exist: Goulburn Valley Water and North East Regional Water Authority. Each Authority is currently preparing a Water Supply Demand Strategy (WSDS). The aim of the WSDS is to secure town water supplies throughout the region and identifies actions necessary to meet increases in demand, resulting from population and industry growth in the area. The Strategy has a 50 year time frame (2006-2056). Both Authorities have a Drought Response Manual for townships which they service. These plans aim to ensure the provision of a supply system that satisfies current and future demands, ensuring that shortfalls in supply are within 'acceptable' levels; and ensuring that when shortfalls in supply occur, a range of appropriate response mechanisms are available.

## Goulburn-Murray Water Dry Inflow Contingency Planning

Goulburn-Murray Water is currently undertaking dry inflow contingency planning. The process is examining how water resources can be managed to meet stock and domestic, irrigation and bulk supply demands under the following inflow scenarios:

- a repeat of 2006/07 (i.e. worst on record in most cases);
- 99% probability of exceedence Inflow (i.e 1 in 100 year event e.g. 1982-83); and
- 95% probability of exceedence Inflow (i.e 1 in 20 year event).
- 90% probability of exceedence Inflow (i.e 1 in 10 year event).

## Victorian Bushfire Reconstruction and Recovery Authority

In early 2009, bushfires swept across Victoria, devastating 78 communities and 400, 000 hectares of land. A total of 173 people lost their lives. The devastation resulted in 2029 homes destroyed along with 61 businesses, 5 schools and kindergartens, 3 sporting clubs and numerous other buildings. On 10 February 2009, the Commonwealth and Victorian Governments established the Victorian Bushfire Reconstruction and Recovery Authority to oversee and coordinate the recovery and rebuilding program. The Authority is working with communities, businesses, charities, local councils and other government departments to help rebuild communities affected by the bushfires. The Authority is chaired by Christine Nixon (Victorian State Government 2009).

## 7.0 Communication & Engagement

Informing and involving stakeholders and the wider community during the ongoing development and implementation of this plan is critical to its success. Some of the key messages that need to be communicated include:

- Our rivers are already stressed and while drought conditions are natural the prolonged dry conditions are damaging our most important rivers.
- The Goulburn Broken CMA is working to protect the priority environmental assets during the drought to ensure important communities of endangered and vulnerable species are not lost.
- The Goulburn Broken CMA has a contingency plan which focuses on maintaining the priority environmental areas during the drought. The plan takes into consideration options to maintain the unique and important environmental values within the Goulburn Broken CMA region.
- The Goulburn Broken CMA remains committed to the community with the Drought Employment Program, which provides a much needed economic boost to regional communities currently feeling the flow on effects of the drought.

Table 23 lists the stakeholders that the Goulburn Broken Catchment Management Authority will engage during the development and implementation of the plan and how they will be engaged and when. Where possible, engagement will be co-ordinated with existing processes. In addition, a number of potential communication risks have been identified and actions to address them (Table 24).

Table 23 Stakeholder engagement.

Stakeholder	Method of Engagement	Frequency
Local community	• Produce fact sheet on CMAs role during Dry Inflow and activities planned.	• Distribute via website and as required
	• Joint media releases with G-MW when Qualification of Rights take place.	• As required
	• Respond to requests for information.	• As required
	• Media releases around good news stories – e.g. Drought Employment Program.	• As available
	• Continue to support the Drought Employment Program.	• Ongoing
	• Prompt media releases about any negative events e.g. fish kills. If possible these should re-iterate positive actions the CMA is undertaking to avoid repeat events.	• As required
	• Provide input to Goulburn-Murray Water's Dry Inflow response newsletters.	• As available
	• Develop Dry Inflow page on website and update to ensure activities remain current.	• Update at least monthly
Goulburn-Murray Water	• Gain input from G-MW on GB CMA Dry Inflow response plan.	• ASAP
	• 1:1 communication.	• Ongoing
	• Joint media releases when Qualification of Rights take place.	• As required
	• Informal discussions regarding joint Dry Inflow management.	• Ongoing
	• Providing environmental advice on Water Supply Demand Strategies.	• As required
Goulburn Valley Water and North East Regional Water Authorities	• 1:1 communication.	• Ongoing
Landcare groups/ Greening Australia	• Use as forum to promote CMA activities throughout Dry Inflow.	• Opportunistic
EPA	• Establish common means of dealing with communications when fish kills occur e.g. joint media releases.	• Ongoing
	• Provide support to deal with communications when fish kills occur e.g. joint media releases.	• As required

Table 23 (continued).

Stakeholder	Method of Engagement	Frequency
DSE	<ul style="list-style-type: none"> <li>• CEO Forums/teleconferences.</li> <li>• 1:1 communication.</li> <li>• Attendance at EWRO meetings.</li> <li>• Attendance at Waterway Managers meetings.</li> </ul>	<ul style="list-style-type: none"> <li>• As required</li> <li>• Ongoing</li> <li>• 3 monthly</li> <li>• As required</li> </ul>
DPI Fisheries	<ul style="list-style-type: none"> <li>• Establish common means of dealing with communications when fish kills occur e.g. joint media releases.</li> <li>• Providing support to DPI Fisheries in the event of a fish kill.</li> </ul>	<ul style="list-style-type: none"> <li>• Ongoing</li> <li>• As required</li> </ul>

Table 24 Communication risks.

Risk	Management Action
Communities may negatively react to water being allocated for the environment.	<p>Clearly promote:</p> <ul style="list-style-type: none"> <li>• The message that key endangered or vulnerable environmental assets are being targeted.</li> <li>• Complementary works that are being undertaken to protect environmental assets.</li> <li>• The message that both communities and the environment are under stress.</li> <li>• The message that 'it's keeping the vine alive, not trying to grow fruit'.</li> </ul>
Inconsistent messages between GB CMA and Goulburn-Murray Water within any Qualifications of Rights	<ul style="list-style-type: none"> <li>• Produce joint media releases where appropriate.</li> <li>• Provide advice as necessary to G-MW on protection of environmental assets when qualifying rights.</li> <li>• Maintain relationships with G-MW to ensure early input during the QoR process.</li> </ul>
Deterioration of GB CMAs reputation during the Dry Inflow	<ul style="list-style-type: none"> <li>• Continue community engagement practices eg landcare, waterwatch, Drought Employment Program.</li> <li>• Engage community in complementary activities as appropriate.</li> <li>• Maintain visible presence in the community throughout the Dry Inflow.</li> <li>• Key messages around the role of GB CMA during Dry Inflow also address some of this risk.</li> </ul>
Lack of stakeholder understanding about the role of GB CMA during the Dry Inflow	<ul style="list-style-type: none"> <li>• Produce communications material outlining GB CMA's roles and priorities during the Dry Inflow.</li> <li>• Reinforce these key messages in all subsequent material relating to GB CMA and Dry Inflow.</li> </ul>

## 8.0 References

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# Appendix 1- Priority Ecological Values

## Ecological Values

Tables 25-28 below lists the ecological values in the Goulburn broken Catchment considered at most serious threat from no or low inflows in 2009-2010.

Table 25 Macroinvertebrates and reptiles at most serious threat from no or low inflows.

Common Name	Scientific Name	Conservation Status			Habitat
		EPBC	FFG	DSE	
Broad-shelled Turtle	<i>Chelodina expansa</i>			EN	Riv/Wet
Carpet Python	<i>Morelia spilota metcalfei</i>		L	EN	Riv
Common Long-necked Turtle	<i>Chelodina longicollis</i>				Riv/Wet
Damselfly	<i>Hemiphysalia mirabilis</i>		L	VU	Riv
Murray Spiny Cray	<i>Euastacus armatus</i>		L	DD	Riv
Stonefly	<i>Thaumatoperla flaveola</i>		L	VU	Riv
Swamp Yabby	<i>Cherax rotundas</i>				Riv/Wet

Table 26 Amphibians and fish at most serious threat from no or low inflows.

Common Name	Scientific Name	Conservation Status			Habitat
		EPBC	FFG	DSE	
Barking Marsh Frog	<i>Limnodynastes fletcheri</i>			DD	Riv/Wet
Barred Galaxias <sup>1</sup>	<i>Galaxias fuscus</i>	EN	L	CR	Riv
Brown Toadlet	<i>Pseudophryne bibronii</i>			En	Riv/Wet
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>				Wet
Dwarf Flat-headed Gudgeon <sup>2</sup>	<i>Phlypnodon macrostomus</i>				Riv/Wet
Flat-headed Galaxias	<i>Galaxias rostratus</i>		L	DD	Riv
Freshwater Catfish	<i>Tandanus tandanus</i>		L	EN	Riv
Giant Bullfrog	<i>Limnodynastes interioris</i>		L	CR	Riv/Wet
Golden Perch	<i>Macquaria ambigua</i>		L	VU	Riv
Growling Grass Frog	<i>Litoria raniformis</i>	VU	L	EN	Riv/Wet
Macquarie Perch	<i>Macquaria australasica</i>	CR	L	CR	Riv
Murray Cod	<i>Maccullochella peelii peelii</i>		L	EN	Riv
Murray-Darling Rainbowfish	<i>Melanotaenia fluviatilis</i>		L	DD	Riv
River Blackfish	<i>Gadopsis marmoratus</i>			DD	Riv
Silver Perch	<i>Bidyanus bidyanus</i>		L	CR	Riv
Sloane's Froglet	<i>Crinia sloanei</i>				Riv/Wet
Southern Pygmy Perch <sup>3</sup>	<i>Nannoperca australis</i>				Riv/Wet
Spotted Tree Frog	<i>Litoria spenceri</i>	EN	L	CR	Riv
Trout Cod	<i>Maccullochella macquariensis</i>	EN	L	CR	Riv

1. The Barred Galaxias is endemic to Victoria with a limited range in the headwater reaches of the Goulburn River system.
2. The Dwarf Flat-headed Gudgeon is relatively common in coastal streams. However, they have only been recorded at a few localities in the inland Murray Darling Basin are vulnerable to local extinction(Lintermans 2007).
3. The Southern Pygmy Perch is common in southern coastal Victoria. However it has a fragmented distribution along Victorian tributaries of the Murray and has only been recorded at a limited number of locations in NSW and SA where it is considered highly threatened. Due to its small isolated populations in the Murray Darling Basin it is vulnerable to local extinction (Lintermans 2007).

Table 27 Flora species at most serious threat from no or low inflows.

Common Name	Scientific Name	Conservation Status			Habitat
		EPBC	FFG	DSE	
Amulla <sup>1</sup>	<i>Eremophila debilis</i>			EN	NA
Button Rush	<i>Lipocarpa microcephala</i>			VU	AMPH
Cane Grass	<i>Eragrostis australasica</i>			VU	AMPH
Coolibah Grass	<i>Panicum queenslandicum</i> var. <i>queenslandicum</i>			EN	RWAMPH
Dookie Daisy	<i>Brachyscome gracilis</i>		L	VU	AMPH

Table 27 (continued).

Common Name	Scientific Name	Conservation Status			Habitat
		EPBC	FFG	DSE	
Downs Nutgrass	<i>Cyperus bifax</i>			VU	RAMPH
Flat Spike-sedge	<i>Eleocharis plana</i>			VU	AMPH
Grey Billy-buttons	<i>Craspedia canens</i>			EN	RWAMPH
Moirra Grass	<i>Pseudoraphis spinescens</i>				AMPH
Mueller Daisy	<i>Brachyscome muelleroides</i>	VU	L	EN	RO
Pepper Grass	<i>Panicum laevinode</i>			VU	RWAMPH
Ridged Water-milfoil	<i>Myriophyllum porcatum</i>	VU	L	VU	AMPH
River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	VU			WAMPH
Salt Paperbark	<i>Melaleuca halmaturorum</i> subsp. <i>halmaturorum</i>		L	VU	OLAC
Slender Club-sedge	<i>Isolepis congrua</i>		L	VU	AMPH
Slender Water-milfoil	<i>Myriophyllum gracile</i> var. <i>lineare</i>			EN	AMPH
Striped Water-milfoil	<i>Myriophyllum striatum</i>		L	VU	AMPH
Swamp Star	<i>Hypoxis excilis</i>			VU	ROA
Tangled Lignum	<i>Muehlenbeckia florulenta</i>				AMPH
Water-shield	<i>Brasenia schreberi</i>		L	VU	RWOA
Weeping Myall	<i>Acacia pendula</i>		L	EN	RO
Western Water-starwort	<i>Callitriche cyclocarpa</i>	VU		VU	AMPH
Yellow-tongue Daisy	<i>Brachyscome chrysoglossa</i>		L	VU	AMPH

- 1 Amulla is not an aquatic dependent species. However, this is the only recorded population of this species in Victoria (Parks Victoria 2006).

Table 28 Waterbirds at most serious threat from no or low inflows.

Common Name	Scientific Name	Conservation Status			Habitat
		EPBC	FFG	DSE	
Australasian Bittern	<i>Botaurus poiciloptilus</i>		L	EN	Riv/Wet
Australasian Shoveler	<i>Anas rhynchos</i>			VU	Riv/Wet
Australian Little Bittern	<i>Ixobrychus dubius</i>		L	EN	Riv/Wet
Baillon's Crake	<i>Porzana pusilla palustris</i>		L	VU	Riv/Wet
Blue-billed Duck	<i>Oxyura australis</i>		L	EN	Riv/Wet
Brolga	<i>Grus rubicunda</i>		L	VU	Riv/Wet
Caspian Tern	<i>Sterna caspia</i>		L	NT	Riv/Wet
Eastern Great Egret	<i>Ardea modesta</i>		L	VU	Riv/Wet
Freckled Duck	<i>Stictonetta naevosa</i>		L	EN	Riv/Wet
Gull-billed Tern	<i>Sterna nilotica</i>		L	EN	Riv/Wet
Hardhead	<i>Aythya australis</i>			VU	Riv/Wet
Intermediate Egret	<i>Ardea intermedia</i>		L	CR	Riv/Wet
Lewin's Rail	<i>Lewinia pectoralis</i>		L	VU	Riv/Wet
Little Egret	<i>Egretta garzetta nigripes</i>		L	EN	Riv/Wet
Magpie Goose	<i>Anseranas semipalmata</i>		L	VU	Riv/Wet
Musk Duck	<i>Biziura lobata</i>			VU	Riv/Wet
Painted Snipe	<i>Rostratula benghalensis</i>	VU	L	CR	Riv/Wet
Royal Spoonbill	<i>Platalea regia</i>			VU	Riv/Wet
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>		L	VU	Riv/Wet
Wood Sandpiper	<i>Tringa glareola</i>			VU	Riv/Wet



## Scoring system

High, medium and low priorities have been determined by assigning scores between 0 and 3 to threatened status attributes of the flora and fauna values according to set criteria (Table 29). The flora and fauna values are then ranked according to their accumulative score. Thresholds of high, medium and low priority have then been applied arbitrarily (Table 30).

Table 29 Criteria for scoring threatened status attributes of flora and fauna values.

Conservation Status		Score
EPBC	Critically Endangered	3
	Endangered	2
	Vulnerable	1
FFG	Listed	3
	Not Listed	0
DSE	Critically Endangered	3
	Endangered	2
	Vulnerable	1
	Data Deficient	0

Table 30 Thresholds of high, medium and low priority.

Accumulative Score	Priority
0 - 3	Low
4 - 6	Medium
7 - 9	High

## Priority Ecological Values

Table 31 below lists the flora and fauna values in the Goulburn Broken Catchment considered at most serious threat from no or low inflows in 2009-2010 and their priority ranking.

Table 31 Flora and fauna values at most serious threat from no or low inflows and their priority ranking.

Common Name	Scientific Name	Accum. Score	Priority
Barred Galaxias	<i>Galaxias fuscus</i>	8	High
Dwarf Flat-headed Gudgeon	<i>Philypnodon macrostomus</i>	NA	High
Macquarie Perch	<i>Macquaria australasica</i>	9	High
Painted Snipe	<i>Rostratula benghalensis</i>	7	High
Southern Pygmy Perch	<i>Nannoperca australis</i>	NA	High
Spotted Tree Frog	<i>Litoria spenceri</i>	8	High
Trout Cod	<i>Maccullochella macquariensis</i>	8	High
Australasian Bittern	<i>Botaurus poiciloptilus</i>	5	Medium
Australian Little Bittern	<i>Ixobrychus dubius</i>	5	Medium
Baillon's Crane	<i>Porzana pusilla palustris</i>	4	Medium
Blue-billed Duck	<i>Oxyura australis</i>	5	Medium
Brolga	<i>Grus rubicunda</i>	4	Medium
Carpet Python	<i>Morelia spilota metcalfei</i>	5	Medium
Damselfly	<i>Hemiphysalis mirabilis</i>	4	Medium
Dookie Daisy	<i>Brachyscome gracilis</i>	4	Medium
Eastern Great Egret	<i>Ardea modesta</i>	4	Medium
Freckled Duck	<i>Stictonetta naevosa</i>	5	Medium
Freshwater Catfish	<i>Tandanus tandanus</i>	5	Medium
Giant Bullfrog	<i>Limnodynastes interioris</i>	6	Medium
Golden Perch	<i>Macquaria ambigua</i>	4	Medium
Growling Grass Frog	<i>Litoria raniformis</i>	6	Medium
Gull-billed Tern	<i>Sterna nilotica</i>	5	Medium
Intermediate Egret	<i>Ardea intermedia</i>	6	Medium
Lewin's Rail	<i>Lewinia pectoralis</i>	4	Medium
Little Egret	<i>Egretta garzetta nigripes</i>	5	Medium
Magpie Goose	<i>Anseranas semipalmata</i>	4	Medium
Mueller Daisy	<i>Brachyscome muelleroides</i>	6	Medium
Murray Cod	<i>Maccullochella peelii peelii</i>	5	Medium
Ridged Water-milfoil	<i>Myriophyllum porcatum</i>	5	Medium
Salt Paperbark	<i>Melaleuca halmaturorum subsp. halmaturorum</i>	4	Medium
Silver Perch	<i>Bidyanus bidyanus</i>	6	Medium
Slender Club-sedge	<i>Isolepis congrua</i>	4	Medium

Table 31 (continued).

Common Name	Scientific Name	Accum. Score	Priority
Stonefly	<i>Thaumatoperla flaveola</i>	4	Medium
Striped Water-milfoil	<i>Myriophyllum striatum</i>	4	Medium
Water-shield	<i>Brasenia schreberi</i>	4	Medium
Weeping Myall	<i>Acacia pendula</i>	5	Medium
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	4	Medium
Yellow-tongue Daisy	<i>Brachyscome chrysoglossa</i>	4	Medium
Amulla	<i>Eremophila debilis</i>	2	Low
Australasian Shoveler	<i>Anas rhynchotis</i>	1	Low
Broad-shelled Turtle	<i>Chelodina expansa</i>	2	Low
Brown Toadlet	<i>Pseudophryne bibronii</i>	2	Low
Button Rush	<i>Lipocarpha microcephala</i>	1	Low
Cane Grass	<i>Eragrostis australasica</i>	1	Low
Caspian Tern	<i>Sterna caspia</i>	3	Low
Common Long-necked Turtle	<i>Chelodina longicollis</i>	0	Low
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	0	Low
Coolibah Grass	<i>Panicum queenslandicum</i> var. <i>queenslandicum</i>	2	Low
Downs Nutgrass	<i>Cyperus bifax</i>	1	Low
Flat Spike-sedge	<i>Eleocharis plana</i>	1	Low
Flat-headed Galaxias	<i>Galaxias rostratus</i>	3	Low
Grey Billy-buttons	<i>Craspedia canens</i>	2	Low
Hardhead	<i>Aythya australis</i>	1	Low
Moirra Grass	<i>Pseudoraphis spinescens</i>	0	Low
Murray Spiny Cray	<i>Euastacus armatus</i>	3	Low
Murray-Darling Rainbowfish	<i>Melanotaenia fluviatilis</i>	3	Low
Musk Duck	<i>Biziura lobata</i>	1	Low
Pepper Grass	<i>Panicum laevinode</i>	1	Low
River Blackfish	<i>Gadopsis marmoratus</i>	0	Low
River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	1	Low
Royal Spoonbill	<i>Platalea regia</i>	1	Low
Slender Water-milfoil	<i>Myriophyllum gracile</i> var. <i>lineare</i>	2	Low
Sloane's Froglet	<i>Crinia sloanei</i>	0	Low
Swamp Star	<i>Hypoxis excilis</i>	1	Low
Tangled Lignum	<i>Muehlenbeckia florulenta</i>	0	Low
Western Water-starwort	<i>Callitriche cyclocarpa</i>	2	Low
Wood Sandpiper	<i>Tringa glareola</i>	1	Low

## Regulated Streams

Table 32 below lists the regulated streams that support or provide refuge for priority ecological values and the reach(s) in which the priority ecological values have been recorded where known or relevant.

Table 32 Regulated streams that support or provide refuge for priority ecological values.

Stream	Reach	Ecological Value		Priority
		Common Name	Scientific Name	
Boosey Creek <sup>1</sup>	32	Amulla	<i>Eremophila debilis</i>	Low
	33	Australasian Shoveler	<i>Anas rhynchotis</i>	Low
	32	Coolibah Grass	<i>Panicum queenslandicum</i> var. <i>queenslandicum</i>	Low
	33	Eastern Great Egret	<i>Ardea modesta</i>	Medium
	34	Growling Grass Frog	<i>Litoria raniformis</i>	Medium
	33	Hardhead	<i>Aythya australis</i>	Low
	TBD	Pepper Grass	<i>Panicum laevinode</i>	Low
	34	Slender Club-sedge	<i>Isolepis congrua</i>	Medium
Broken Creek		Australasian Bittern	<i>Botaurus poiciloptilus</i>	Medium
		Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Blue-billed Duck	<i>Oxyura australis</i>	Medium
		Brolga	<i>Grus rubicunda</i>	High
	21, 22, 24	Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Freckled Duck	<i>Stictonetta naevosa</i>	Medium
	24	Golden Perch	<i>Macquaria ambigua</i>	Medium
	21	Hardhead	<i>Aythya australis</i>	Low
		Intermediate Egret	<i>Ardea intermedia</i>	Medium

Table 32 (continued).

Stream	Reach	Ecological Value		Priority
		Common Name	Scientific Name	
Broken Creek		Little Egret	<i>Egretta garzetta nigripes</i>	Medium
	21 - 23	Murray Cod	<i>Maccullochella peelii peelii</i>	Medium
		Musk Duck	<i>Biziura lobata</i>	Low
	22	Ridged Water-milfoil	<i>Myriophyllum porcatum</i>	Medium
		Royal Spoonbill	<i>Platalea regia</i>	Low
	24	Slender Water-milfoil	<i>Myriophyllum gracile</i> var. <i>lineare</i>	Low
	TBD	Striped Water-milfoil	<i>Myriophyllum striatum</i>	Medium
		White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
Broken River	24	Yellow-tongue Daisy	<i>Brachyscome chrysoglossa</i>	Medium
	5	Australasian Shoveler	<i>Anas rhynchotis</i>	Low
	3, 5	Eastern Great Egret	<i>Ardea modesta</i>	Medium
	1-4	Golden Perch	<i>Macquaria ambigua</i>	Medium
	5	Hardhead	<i>Aythya australis</i>	Low
	3 - 5	Macquarie Perch	<i>Macquara australasica</i>	High
	1-5	Murray Cod	<i>Maccullochella peelii peelii</i>	Medium
	1-5	Murray-Darling rainbowfish	<i>Melanotaenia fluviatilis</i>	Low
	5	Musk Duck	<i>Biziura lobata</i>	Low
	2,3, 5	Royal Spoonbill	<i>Platalea regia</i>	Low
	1	Silver Perch	<i>Bidyanus bidyanus</i>	Medium
	1-4	Trout Cod	<i>Maccullochella macquariensis</i>	High
	5	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
Goulburn River below Lake Eildon	5, 9-12, 14	Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Australian Little Bittern	<i>Ixobrychus dubius</i>	Medium
	10	Baillon's Crane	<i>Porzana pusilla palustris</i>	Medium
	10	Blue-billed Duck	<i>Oxyura australis</i>	Medium
	9	Brolga	<i>Grus rubicunda</i>	High
	4, 12	Brown Toadlet	<i>Pseudophryne bibronii</i>	Low
	1, 6-12, 14	Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Freckled Duck	<i>Stictonetta naevosa</i>	Medium
	1, 4, 6	Growling Grass Frog	<i>Litoria raniformis</i>	Medium
	9, 10, 12, 14	Hardhead	<i>Aythya australis</i>	Low
		Little Egret	<i>Egretta garzetta nigripes</i>	Medium
		Magpie Goose	<i>Anseranas semipalmata</i>	Medium
	1 - 8	Murray Cod	<i>Maccullochella peelii peelii</i>	Medium
	9, 11, 14	Musk Duck	<i>Biziura lobata</i>	Low
	14	Painted Snipe	<i>Rostratula benghalensis</i>	High
	6	River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	Low
	6, 7, 9, 11, 14	Royal Spoonbill	<i>Platalea regia</i>	Low
	1 - 8	Silver Perch	<i>Bidyanus bidyanus</i>	Medium
	9	Water-shield <sup>2</sup>	<i>Brasenia schreberi</i>	Medium
	3	Western Water-starwort	<i>Callitriche cyclocarpa</i>	Low
	4, 9	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
Nine Mile Creek	29	Grey Billy-buttons	<i>Craspedia canens</i>	Low
	29	Australasian Shoveler	<i>Anas rhynchotis</i>	Low
	29	Brolga	<i>Grus rubicunda</i>	High
	28, 29	Eastern Great Egret	<i>Ardea modesta</i>	Medium

<sup>1</sup> The Boosey Creek above Tungamah is unregulated. However, in the Plan it is discussed in conjunction with the regulated section.

<sup>2</sup> Water-shield was recorded at Lake Nagambie on the Goulburn River, which is a wetland of bioregional significance.

## Unregulated Streams

Table 33 below lists the unregulated streams that support or provide refuge for priority ecological values and the reach(s) in which the priority ecological values have been recorded where known or relevant.

Table 33 Unregulated streams that support or provide refuge for priority ecological values.

Stream	Reach	Ecological Value		Priority
		Common Name	Scientific Name	
Acheron River	63	Brown Toadlet	<i>Pseudophryne bibronii</i>	Low
	63	Murray Spiny Cray	<i>Euastacus armatus</i>	Low
	62	Musk Duck	<i>Biziura lobata</i>	Low
Big River	68	Ecologically healthy river		High
	67	Spotted Tree Frog	<i>Litoria spenceri</i>	High
Delatite River	71	Murray Cod	<i>Maccullochella peelii peelii</i>	Medium
	72	Stonefly	<i>Thaumatoperla flaveola</i>	Medium
Goulburn River above Lake Eildon	16	Barred Galaxias	<i>Galaxias fuscus</i>	High
	15	Ecologically Healthy River		High
	15	Macquarie Perch	<i>Macquara australasica</i>	High
	16	Spotted Tree Frog	<i>Litoria spenceri</i>	High
Holland Creek	14	Brown Toadlet	<i>Pseudophryne bibronii</i>	Low
	14	Dookie Daisy	<i>Brachyscome gracilis</i>	Medium
	13-14	Macquarie Perch	<i>Macquara australasica</i>	High
Howqua River	70	Spotted Tree Frog	<i>Litoria spenceri</i>	High
Hughes Creek	37	Macquarie Perch	<i>Macquara australasica</i>	High
	37	Murray Cod	<i>Maccullochella peelii peelii</i>	Medium
King Parrot Creek	51	Macquarie Perch	<i>Macquara australasica</i>	High
Leary's Creek	NA	Barred Galaxias	<i>Galaxias fuscus</i>	High
Rubicon River	66	Barred Galaxias	<i>Galaxias fuscus</i>	High
Ryans Creek	17	Ecologically healthy river		High
Seven Creeks	16-17	Growling Grass Frog	<i>Litoria raniformis</i>	Medium
	16-17	Eastern Great Egret	<i>Ardea modesta</i>	Medium
	17, 20	Eastern Great Egret	<i>Ardea modesta</i>	Medium
	20	Hardhead	<i>Aythya australis</i>	Low
	19-20	Macquarie Perch	<i>Macquara australasica</i>	High
	20	Murray Spiny Cray	<i>Euastacus armatus</i>	Low
	17	Royal Spoonbill	<i>Platalea regia</i>	Low
	19	Trout Cod	<i>Maccullochella macquariensis</i>	High
	17	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
Sunday Creek	NA	Barred Galaxias	<i>Galaxias fuscus</i>	High
Taggerty River	64	Barred Galaxias	<i>Galaxias fuscus</i>	High
	64	Ecologically healthy river		High
	64	Growling Grass Frog	<i>Litoria raniformis</i>	Medium
Sreavenson River	NA	Barred Galaxias	<i>Galaxias fuscus</i>	High
Yea River	54	Australasian Shoveler	<i>Anas rhynchos</i>	Low
	54	Damselfly	<i>Hemiphysalis mirabilis</i>	Medium
	54, 57	Eastern Great Egret	<i>Ardea modesta</i>	Medium
	54	Hardhead	<i>Aythya australis</i>	Low
	57	Lewin's Rail	<i>Lewinia pectoralis</i>	Medium
	55	Macquarie Perch	<i>Macquara australasica</i>	High
	54, 57	Musk Duck	<i>Biziura lobata</i>	Low
	57	Royal Spoonbill	<i>Platalea regia</i>	Low

## Wetlands

Table 34 below lists the 33 wetlands that support or provide refuge for priority ecological values.

Table 34 Wetlands streams that support or provide refuge for priority ecological values.

Wetland	Status	Ecological Value		Priority
		Common Name	Scientific Name	
Barmah Forest	Ramsar Site, VWR	Brolga	<i>Grus rubicunda</i>	High
		Dwarf Flat-headed Gudgeon <sup>1</sup>	<i>Philypnodon macrostomus</i>	High
		Macquarie Perch	<i>Macquara australasica</i>	High
		Southern Pygmy Perch <sup>1</sup>	<i>Nannoperca australis</i>	High
		Trout Cod	<i>Maccullochella macquariensis</i>	High
		Australasian Bittern	<i>Botaurus poiciloptilus</i>	Medium
		Australasian Bittern	<i>Botaurus poiciloptilus</i>	Medium
		Australian Little Bittern	<i>Ixobrychus dubius</i>	Medium
		Australian Little Bittern	<i>Ixobrychus dubius</i>	Medium
		Baillon's Crake	<i>Porzana pusilla palustris</i>	Medium
		Blue-billed Duck	<i>Oxyura australis</i>	Medium
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Freshwater Catfish	<i>Tandanus tandanus</i>	Medium
		Giant Bullfrog <sup>4</sup>	<i>Limnodynastes interioris</i>	Medium
		Golden Perch <sup>3</sup>	<i>Macquaria ambigua</i>	Medium
		Growling Grass Frog <sup>4</sup>	<i>Litoria raniformis</i>	Medium
		Intermediate Egret	<i>Ardea intermedia</i>	Medium
		Little Egret	<i>Egretta garzetta nigripes</i>	Medium
		Mueller Daisy	<i>Brachyscome muelleroides</i>	Medium
		Murray Cod <sup>3</sup>	<i>Maccullochella peelii peelii</i>	Medium
		Silver Perch <sup>3</sup>	<i>Bidyanus bidyanus</i>	Medium
		White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
		Yellow-tongue Daisy	<i>Brachyscome chrysoglossa</i>	Medium
		Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Barking Marsh Frog <sup>1</sup>	<i>Limnodynastes fletcheri</i>	Low
		Broad-shelled Turtle <sup>2</sup>	<i>Chelodina expansa</i>	Low
		Brown Toadlet <sup>1</sup>	<i>Pseudophryne bibronii</i>	Low
		Button Rush	<i>Lipocarpha microcephala</i>	Low
		Common Long-necked Turtle <sup>2</sup>	<i>Chelodina longicollis</i>	Low
		Common Spadefoot Toad <sup>1</sup>	<i>Neobatrachus sudelli</i>	Low
		Downs Nutgrass	<i>Cyperus bifax</i>	Low
		Flat-headed Galaxias	<i>Galaxias rostratus</i>	Low
		Hardhead	<i>Aythya australis</i>	Low
		Moir Grass <sup>5</sup>	<i>Pseudoraphis spinescens</i>	Low
		Murray Spiny Cray	<i>Euastacus armatus</i>	Low
		Murray-Darling Rainbowfish <sup>3</sup>	<i>Melanotaenia fluviatilis</i>	Low
		Musk Duck	<i>Biziura lobata</i>	Low
		River Blackfish	<i>Gadopsis marmoratus</i>	Low
		River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low
		Sloane's Froglet <sup>1</sup>	<i>Crinia sloanei</i>	Low
		Swamp Yabby <sup>6</sup>	<i>Cherax rotundas</i>	Low
Black Swamp	VWR	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
		River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low
Boosey Creek Wetland	VWR	Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Swamp Star	<i>Hypoxis exilis</i>	Low
Brays Swamp	VWR	Brolga	<i>Grus rubicunda</i>	High
Broken Creek Wetland <sup>B</sup>	WONS, VWR	Brolga	<i>Grus rubicunda</i>	High
Cemetery Bend <sup>G</sup>	WONS, VWR	Eastern Great Egret	<i>Ardea modesta</i>	Medium

Table 34 (continued).

Wetland	Status	Ecological Value		Priority
		Common Name	Scientific Name	
Cornella Creek Wetland	VWR	Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Hardhead	<i>Aythya australis</i>	Low
		Musk Duck	<i>Biziura lobata</i>	Low
Cornella Creek Wetland	VWR	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
		Royal Spoonbill	<i>Platalea regia</i>	Low
Corop Swamp	VWR	Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Hardhead	<i>Aythya australis</i>	Low
Cussen Park	VWR	Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Royal Spoonbill	<i>Platalea regia</i>	Low
Doctors Swamp	VWR	Brolga	<i>Grus rubicunda</i>	High
		Blue-billed Duck	<i>Oxyura australis</i>	Medium
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Caspian Tern	<i>Sterna caspia</i>	Low
		Hardhead	<i>Aythya australis</i>	Low
		Musk Duck	<i>Biziura lobata</i>	Low
Gaynor Swamp <sup>w</sup>	WONS, VWR	Brolga	<i>Grus rubicunda</i>	High
		Australasian Bittern	<i>Botaurus poiciloptilus</i>	Medium
		Australian Little Bittern	<i>Ixobrychus dubius</i>	Medium
		Blue-billed Duck	<i>Oxyura australis</i>	Medium
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Freckled Duck	<i>Stictonetta naevosa</i>	Medium
		Intermediate Egret	<i>Ardea intermedia</i>	Medium
		Little Egret	<i>Egretta garzetta nigripes</i>	Medium
		Swamp Paperbark	<i>Melaleuca halmaturorum</i> subsp. <i>halmaturorum</i>	Medium
		Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Hardhead	<i>Aythya australis</i>	Low
		Musk Duck	<i>Biziura lobata</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low
Gemmills Swamp <sup>G</sup>	WONS, VWR	Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Australian Little Bittern	<i>Ixobrychus dubius</i>	Medium
		Blue-billed Duck	<i>Oxyura australis</i>	Medium
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Hardhead	<i>Aythya australis</i>	Low
		Little Egret	<i>Egretta garzetta nigripes</i>	Medium
		Musk Duck	<i>Biziura lobata</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low
Goose Swamp <sup>#</sup>	Ramsar Site, VWR	Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Intermediate Egret	<i>Ardea intermedia</i>	Medium
		Little Egret	<i>Egretta garzetta nigripes</i>	Medium
		Musk Duck	<i>Biziura lobata</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low
		White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
Greens Lake	VWR	Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Blue-billed Duck	<i>Oxyura australis</i>	Medium
		Brolga	<i>Grus rubicunda</i>	High
Greens Lake	VWR	Caspian Tern	<i>Sterna caspia</i>	Low
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Freckled Duck	<i>Stictonetta naevosa</i>	Medium
		Gull-billed Tern	<i>Sterna nilotica</i>	Medium
		Hardhead	<i>Aythya australis</i>	Low
		Musk Duck	<i>Biziura lobata</i>	Low
Greens Swamp	VWR	Royal Spoonbill	<i>Platalea regia</i>	Low
		Brolga	<i>Grus rubicunda</i>	High
		Ridged Water-milfoil	<i>Myriophyllum porcatum</i>	Medium
		Western Water-starwort	<i>Callitriche cyclocarpa</i>	Low

Table 34 (continued).

Wetland	Status	Ecological Value		Priority
		Common Name	Scientific Name	
Horse-shoe Lake	VWR	Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Hardhead	<i>Aythya australis</i>	Low
		Freckled Duck	<i>Stictonetta naevosa</i>	Medium
Kanyapella Basin	WONS, VWR	Brolga	<i>Grus rubicunda</i>	High
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Musk Duck	<i>Biziura lobata</i>	Low
		Painted Snipe	<i>Rostratula benghalensis</i>	High
		River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low
Kinnairds Swamp	VWR	Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Baillon's Crake	<i>Porzana pusilla palustris</i>	Medium
		Brolga	<i>Grus rubicunda</i>	High
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Ridged Water-milfoil	<i>Myriophyllum porcatum</i>	Medium
		Slender Water-milfoil	<i>Myriophyllum gracile</i> var. <i>lineare</i>	Low
		White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
Lake Stewart	VWR	Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Brolga	<i>Grus rubicunda</i>	High
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Hardhead	<i>Aythya australis</i>	Low
		Musk Duck	<i>Biziura lobata</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low
Loch Garry <sup>G</sup>	WONS, VWR	Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Hardhead	<i>Aythya australis</i>	Low
		Musk Duck	<i>Biziura lobata</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low
		White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
Mansfield Swamp <sup>W</sup>	WONS, VWR	Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Blue-billed Duck	<i>Oxyura australis</i>	Medium
		Brolga	<i>Grus rubicunda</i>	High
		Cane Grass	<i>Eragrostis australasica</i>	Low
		Caspian Tern	<i>Sterna caspia</i>	Low
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
Mansfield Swamp <sup>W</sup>	WONS, VWR	Hardhead	<i>Aythya australis</i>	Low
		Little Egret	<i>Egretta garzetta nigripes</i>	Medium
Moodies Swamp <sup>B</sup>	WONS, VWR	Royal Spoonbill	<i>Platalea regia</i>	Low
		Australasian Bittern	<i>Botaurus poiciloptilus</i>	Medium
		Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Baillon's Crake	<i>Porzana pusilla palustris</i>	Medium
		Blue-billed Duck	<i>Oxyura australis</i>	Medium
		Brolga	<i>Grus rubicunda</i>	High
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Freckled Duck	<i>Stictonetta naevosa</i>	Medium
		Hardhead	<i>Aythya australis</i>	Low
		Intermediate Egret	<i>Ardea intermedia</i>	Medium
		Little Egret	<i>Egretta garzetta nigripes</i>	Medium
		Musk Duck	<i>Biziura lobata</i>	Low
		Ridged Water-milfoil	<i>Myriophyllum porcatum</i>	Medium
		Royal Spoonbill	<i>Platalea regia</i>	Low
		Slender Water-milfoil	<i>Myriophyllum gracile</i> var. <i>lineare</i>	Low
		White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium

Table 34 (continued).

Wetland	Status	Ecological Value		Priority
		Common Name	Scientific Name	
Muckatah Depression	WONS	Australasian Bittern	<i>Botaurus poiciloptilus</i>	Medium
		Australasian Shoveler	<i>Anas rhynchos</i>	Low
		Brolga	<i>Grus rubicunda</i>	High
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Hardhead	<i>Aythya australis</i>	Low
		Intermediate Egret	<i>Ardea intermedia</i>	Medium
Muckatah Depression	WONS	Musk Duck	<i>Biziura lobata</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low
		White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
Murray Road Wetland	VWR	Brolga	<i>Grus rubicunda</i>	High
One Tree Swamp <sup>W</sup>	WONS, VWR	Australasian Bittern	<i>Botaurus poiciloptilus</i>	Medium
		Brolga	<i>Grus rubicunda</i>	High
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
Reedy Swamp	WONS, VWR	Australasian Bittern	<i>Botaurus poiciloptilus</i>	Medium
		Australian Little Bittern	<i>Ixobrychus dubius</i>	Medium
		Baillon's Crake	<i>Porzana pusilla palustris</i>	Medium
		Blue-billed Duck	<i>Oxyura australis</i>	Medium
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Freckled Duck	<i>Stictonetta naevosa</i>	Medium
		Hardhead	<i>Aythya australis</i>	Low
		Intermediate Egret	<i>Ardea intermedia</i>	Medium
		Lewin's Rail	<i>Lewinia pectoralis</i>	Medium
		Little Egret	<i>Egretta garzetta nigripes</i>	Medium
		Magpie Goose	<i>Anseranas semipalmata</i>	Medium
		Musk Duck	<i>Biziura lobata</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low
		White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
Ross Swamp	VWR	Australasian Shoveler	<i>Anas rhynchos</i>	Low
		Hardhead	<i>Aythya australis</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low
Stockyard Plain	VWR	Brolga	<i>Grus rubicunda</i>	High
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Hardhead	<i>Aythya australis</i>	Low
Tahbilk Lagoon	VWR	Broad-shelled Turtle	<i>Chelodina expansa</i>	Low
		Freshwater Catfish	<i>Tandanus tandanus</i>	Medium
		Murray-Darling Rainbowfish	<i>Melanotaenia fluviatilis</i>	Low
		Water-shield	<i>Brasenia schreberi</i>	Medium
Timmering Depression	VWR	Hardhead	<i>Aythya australis</i>	Low
		Cane Grass	<i>Eragrostis australasica</i>	Low
Two Tree Swamp <sup>W</sup>	WONS, VWR	Australasian Bittern	<i>Botaurus poiciloptilus</i>	Medium
		Brolga	<i>Grus rubicunda</i>	High
		Hardhead	<i>Aythya australis</i>	Low
Wallenjoe Wetlands <sup>W</sup>	WONS, VWR	Australasian Bittern	<i>Botaurus poiciloptilus</i>	Medium
		Australasian Shoveler	<i>Anas rhynchos</i>	Low
		Australian Little Bittern	<i>Ixobrychus dubius</i>	Medium
		Blue-billed Duck	<i>Oxyura australis</i>	Medium
		Brolga	<i>Grus rubicunda</i>	High



Table 34 (continued).

Wetland	Status	Ecological Value		Priority
		Common Name	Scientific Name	
Wallenjoe Wetlands <sup>W</sup>	WONS, VWR	Cane Grass	<i>Eragrostis australasica</i>	Low
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Freckled Duck	<i>Stictonetta naevosa</i>	Medium
		Hardhead	<i>Aythya australis</i>	Low
		Intermediate Egret	<i>Ardea intermedia</i>	Medium
		Little Egret	<i>Egretta garzetta nigripes</i>	Medium
		Musk Duck	<i>Biziura lobata</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low
		Salt Paperbark	<i>Melaleuca halmaturorum</i> subsp. <i>halmaturorum</i>	Medium
		White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Medium
Woolwash Swamp	VWR	Australasian Bittern	<i>Botaurus poiciloptilus</i>	Medium
		Australasian Shoveler	<i>Anas rhynchotis</i>	Low
		Brolga	<i>Grus rubicunda</i>	High
		Eastern Great Egret	<i>Ardea modesta</i>	Medium
		Hardhead	<i>Aythya australis</i>	Low
		Musk Duck	<i>Biziura lobata</i>	Low
		Royal Spoonbill	<i>Platalea regia</i>	Low

1 Small populations vulnerable to local extinction (Ward, pers. comm. 2007).

2 Long lived species with low recruitment that would benefit from off-stream flooding (Ward, pers. comm. 2007).

3 Barmah provides important habitat for these values.

4 No formal records, but the species is suspected to be utilising the area (Ward, pers. comm. 2007).

5 Barmah has the most extensive areas of Moira Grass plains in Victoria (DCE 1992)).

6 Currently there is only limited information on the biology, abundance and population status of the Swamp Yabby. However, it is thought to be rare.

# Goose Swamp is part of the Barmah Forest Ramsar Site.

B These wetlands are part of the Broken Creek floodplain listed on the Directory of Important Wetlands in Australia.

W These wetlands are part of the Wallenjoe wetland complex listed on the Directory of Important Wetlands in Australia.

G These wetlands are part of the Lower Goulburn River Floodplain listed on the Directory of Important Wetlands in Australia.

Ramsar Listed under the International Convention on Wetlands (Ramsar, Iran, 1971)

WONS Wetland of national significance listed in a Directory of Important Wetlands in Australia

WOBS Wetland of bioregional significance identified for the National Land and Water Resources Audit

## Appendix 2 - Environmental Water Provisions

### Introduction

The Victorian Government amended the Water Act 1989 in December 2005 to create the Environmental Water Reserve. The Environmental Water Reserve comprises water set aside for the environment:

- as an environmental entitlement;
- through the operation of conditions on any bulk entitlement, or any licence, permit or condition issued or regulations made under this or any other Act; and
- any other provision of or regulation made under the Water Act 1989 or the Murray-Darling Basin Act 1993.

Conceptually, environmental water can be:

- minimum flows (and other rules-based flows);
- specific entitlements for the environment; and
- all other water not used for consumptive purposes (“the rest”).

Table 35 below summaries the annual environmental water entitlements available for use in the Goulburn Broken Catchment.

Table 35 Goulburn Broken annual environmental water entitlements.

Annual Environmental Water Entitlement	Total Volume (ML)	Responsible Agency	Sites where the Environmental Water Can be Used								
			Goulburn River	Broken River	Lower Broken Creek	Murray River	Unreg. Streams	Barmah Millewa Forest	Stockyard Plain (Wetland)	Gaynors Swamp	One Tree Swamp
Murray Living Murray Environmental Entitlement	97,390 <sup>1</sup>	MDBC	-	-	-	√	-	√	-	-	-
Goulburn Living Murray BE	141,046 <sup>1</sup>	MDBC	-	-	-	√	-	-	-	-	-
Broken Living Murray Environmental Entitlement	3022 <sup>1</sup>	MDBC	-	-	-	√	-	-	-	-	-
Goulburn Snowy Environmental Reserve BE	15,352 <sup>2</sup>	DSE	-	-	-	-	-	-	-	-	-
Broken Snowy Environmental Reserve BE	990 <sup>2</sup>	DSE	-	-	-	-	-	-	-	-	-
Barmah-Millewa Forest Entitlement	150,000 <sup>3</sup>	DSE	-	-	-	-	-	√	-	-	-
Victorian River Murray Flora and Fauna BE	27,600 <sup>4</sup>	DSE	√	-	√	√	-	√	√	√	√
Stockyard Plain BE	112 <sup>5</sup>	DSE	√	√	√	√	-	√	√	√	√
One Tree Swamp BE	9.3 <sup>5</sup>	PV	√	√	√	√	-	√	√	√	√
Gaynors Swamp BE	40.2 <sup>6</sup>	PV	√	√	√	√	-	√	√	√	√
Goulburn Water Quality Allowance	30,000 <sup>7</sup>	G-MW	√	-	√	-	-	-	-	-	-
Goulburn River Additional Passing Flows	80,000 <sup>8</sup>	DSE	√	-	-	-	-	-	-	-	-
Summer Minimum Flow (see text below)	NA	G-MW	√	√	-	√	√	-	-	-	-
Winter Minimum Flow (see text below)	NA	G-MW	√	√	-	√	√	-	-	-	-
Surplus (unregulated) flows <sup>9</sup>	NA	G-MW	√	√	√	√	√	√	-	-	-
Total	545,561.5										

1. Peak use annual entitlement. Availability is proportional to the availability of low-reliability water shares.

2. May contribute to summer flows in the lower Goulburn and Broken Rivers. An additional 4,800 ML is expected to become available in the near future as a result of the water savings created by the Tungamah pipeline.

3. DSE is responsible for the Barmah component of the entitlement (75,000 ML), though release is approved in conjunction with the NSW Department of Water and Energy and the MDBC. 100,000 ML is high reliability and 50,000 ML is low reliability. The allocation can be accrued up 700,000 ML.

4. Deployed along the length of the Murray River in Victoria. It has been used in the past to supply water to Barmah Forest and wetlands connected to the supply networks of the Goulburn River and lower Broken Creek systems.
5. Can be deployed in the supply networks of the Goulburn River, lower Broken Creek and Murray River Systems.
6. 28.7 ML is high reliability and 11.5 is low reliability. Can be deployed in the supply networks of the Goulburn River, lower Broken Creek and Murray River Systems.
7. Can be deployed in the Goulburn River and lower Broken Creek to manage water quality.
8. Only available in November when the last two years of storage inflows have been good and storage inflows in September and October are low.
9. Surplus River Murray flows under the Murray-Darling Agreement have been used in the past to supply water to Barmah Forest and surplus Broken Creek flows with agreement from Goulburn-Murray Water have been used in the past to supply water to Moodies Swamp on the Broken Creek. Surplus flows on the Broken and Goulburn Rivers could be used in the future to supply water to wetlands with agreement from Goulburn-Murray Water.

## Minimum Flows

### Goulburn River Regulated Supply System

In the Goulburn River below Lake Eildon, the majority of environmental water is contained in provisions within Goulburn-Murray Water's bulk entitlement. The bulk entitlement specifies the following provisions.

- A minimum flow of 120 ML/day from Eildon Pondage Weir, increased to 250 ML/day in any month when the 24 month inflow to Eildon exceeds a trigger flow of approximately 2,780,000 ML. (Trigger is exceeded in roughly 70% of years.)
- A minimum flow of 250 ML/day below Goulburn Weir over any 7 day period, at a daily rate of no less than 200 ML/day.
- A minimum flow at McCoy Bridge (downstream end of Goulburn River) of:
  - 350 ML/day average monthly flow for November to June inclusive, at a daily rate of no less than 300 ML/day; and
  - 400 ML/day average monthly flow for July to October inclusive, at a daily rate of no less than 350 ML/day.
- An additional release from Lake Eildon of up to 80,000 ML during November at a maximum flow rate of up to 16,000 ML/day to provide water to the effluent lagoons for one day, subject to:
  - maximum rates of rise and fall approved by the Minister;
  - the 24 month inflow to Eildon exceeding a trigger flow of approximately 2,780,000 ML;
  - the 12 month inflow to Eildon exceeding a trigger flow of 800,000 ML;
  - the maximum release being reduced where tributary inflows contribute to meeting the objective;
  - the sum of Eildon spill and releases during September and October in that year not exceeding a total of 100,000 ML; and
  - DSE confirming the requirement for the release in that year.
- A range of conditions which limit the harvesting and use of water for consumptive purposes (and protect environmental water in "the rest" category), including limits on storage capacity, size of offtake channels, maximum diversion (10 year rolling average releases and diversions), lake Eildon target filling curves, and rates of rise and fall in releases below lake Eildon.

### Broken River Regulated Supply System

In the Broken River system below Lake Nillahcootie, the majority of environmental water is contained in provisions within Goulburn-Murray Water's bulk entitlement. The bulk entitlement specifies the following provisions.

- A minimum flow over 14 days between Lake Nillahcootie and Broken Weir of the lower of 30 ML/day or natural flow in the months of June to November.
- A minimum flow over 14 days between Broken Weir and Caseys Weir of the lower of 22 ML/day or natural flow in the months of December to May.
- A minimum flow over 14 days between Hollands Weir and the Broken River of the lower of 12 ML/day of natural flow in all months.
- A minimum flow over 14 days between Caseys Weir and the Goulburn River of the lower of 25 ML/day or natural flow in the months of December to May.
- A range of conditions which limit the harvesting and use of water for consumptive purposes (and protect "the rest"), including limits on storage capacity, maximum diversion under the MDB Goulburn-Broken-Loddon cap on water use, and rates of rise and fall in river flows.

Once Lake Mokoan is decommissioned, this entitlement will be cancelled, and the Goulburn-Murray Water bulk entitlement will effectively be adjusted to reduce the ability to harvest and therefore increase water in "the rest" category.

## River Murray Regulated Supply System

The River Murray is operated by the Murray-Darling Basin Commission under the Murray-Darling Basin Agreement. The Murray-Darling Basin Commission provides minimum flows in the River Murray of 1,200 ML/day at Doctor's Point (Albury) and 1,800 ML/day downstream of Yarrawonga Weir.

## Goulburn & Broken Catchment Unregulated Streams

In unregulated systems, there are 2 forms of entitlement. Firstly, urban water and power generation supply systems are governed by bulk entitlements which specify minimum passing flows below diversion points and storages, and maximum storage, and diversion capacities.

Goulburn Valley Water takes supplies from Brewery Creek (Woods Point), Delatite River (Mansfield and Upper Delatite), Mollisons Creek (Pyalong), Nine Mile Creek (Longwood), Rubicon River (Thornton), Seven Creek (Euroa-Violet Town), Steavenson River (Marysville and Buxton), and Yea River (Yea). North East Water takes supplies from Ryans and Whiskey Creeks (Benalla). AGL operates the Rubicon power generation system affecting the Rubicon and Royston Rivers and tributaries.

Secondly, rural water supplies are managed under diversion licences issued by G-MW. The rules under which these licences are managed determines the environmental flows for these stream. Most stream are managed under statewide rules which allows unlimited access to water within the licensed diversion volume.

Work has commenced on developing streamflow management plans for the King Parrot Creek, Yea River and Sevens Creek. A streamflow management plan aims to improve environmental flows (usually minimum flow regimes) and provides a legislative based set of rules to protect the environmental flows.

## Appendix 3 - Impacts of low or no inflow into streams

Below is a simple conceptual model outlining the links between reduced or no inflow in a river, the threats of reduced water quality and reduced habitat and the potential resultant impact of loss of flora and fauna populations.

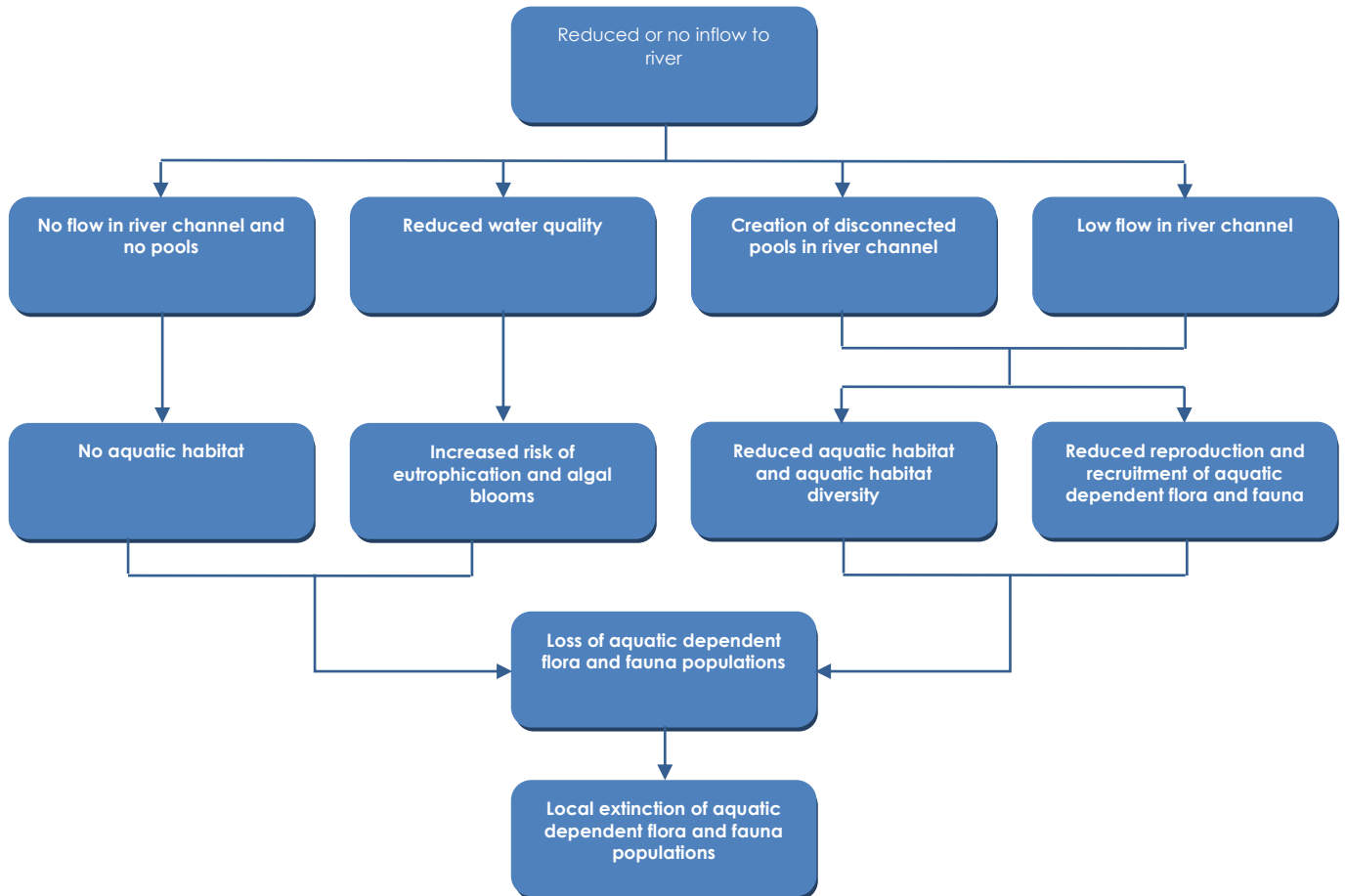


Figure 2 Regulated streams and their reach numbers.



Figure 3 Unregulated streams and their reach numbers.



Figure 4a Priority wetlands.

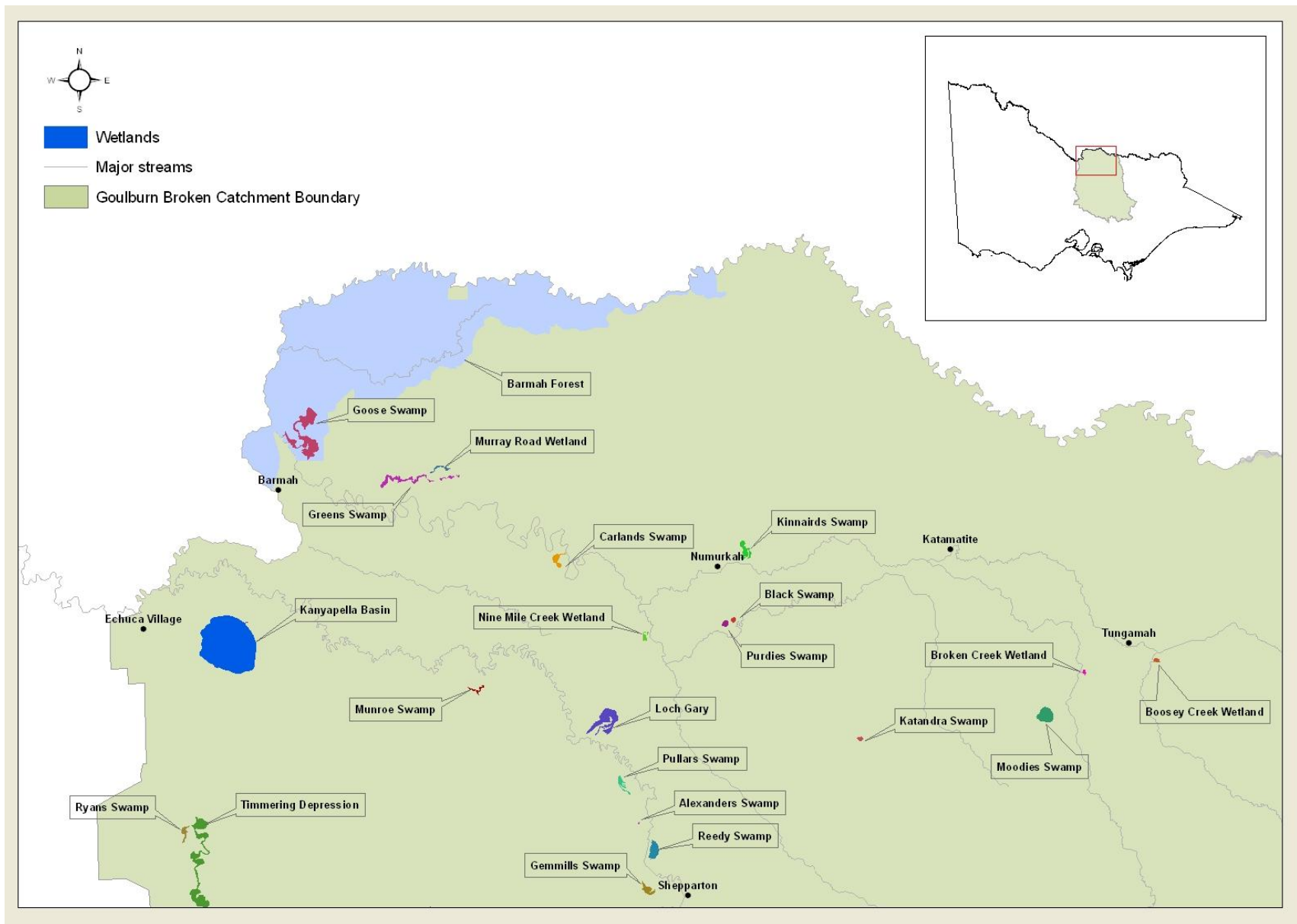




Figure 4b Priority wetlands.

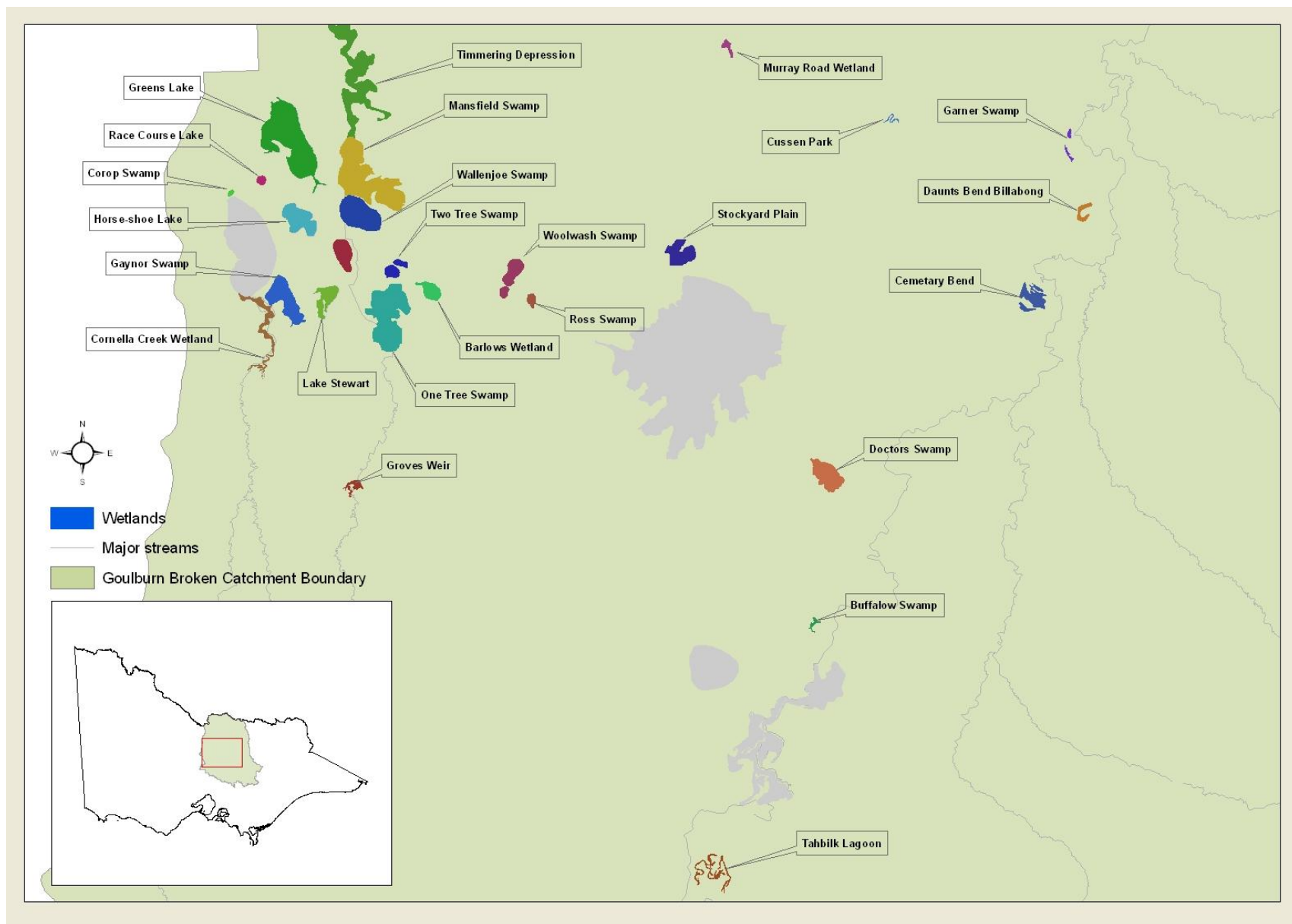


Figure 5 Area burnt in the Goulburn Broken Catchment by the Kilmore East – Murrindindi Complex North Fire.

