

2008-2009

Goulburn Broken Catchment Dry Inflow Contingency Plan



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Executive Summary

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 2008-2009 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 2008/09 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 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 2006/07, 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 2008/09 (habitat loss and reduced water quality) are fish and aquatic dependent amphibians, 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 2008/09. Reedy Swamp, Black Swamp, Kinnarids Swamp and Moodies Swamp are currently the only significant ephemeral wetlands in the catchment holding water, and are therefore providing important breeding and feeding habitat for wetland dependent species, particularly amphibians and waterbirds. As a result, the management of these important drought refuges is also included in the Plan.

A total of 74 actions are identified costing \$1,167,800 that aim to maintain or avoid the local extinction of the priority river, floodplain and wetland assets. 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.
- 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.

Of these actions 30 are of high priority and cost \$664,200. These actions aim to provide drought refuge for wetland dependent species and avoid the local extinction of priority species including Barred Galaxias, Macquarie Perch, Murray Cod, Trout Cod, Dwarf Flat-headed Gudgeon, Southern Pygmy Perch and Silver Perch in the Goulburn River, Broken River, Broken Creek, a number of unregulated streams and Barmah Forest. In contrast, flow in the Broken River in 2007-2008 was consistent with its minimum environmental flow requirements and the threat to priority values was low.

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 North East. 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.

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Glossary

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.

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

Key to tables 1-6

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

Wetland Status:

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

Key to table 7

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
TBD	To be determined

Key to table 8

FSL	Full supply level
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Key to actions in section 5

7GL	Funds received from the sale of 7GL of environmental water
10GL	Anticipated funds from the sale of 10GL 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
GBCMA	Goulburn Broken Catchment Management Authority
G-MW	Goulburn-Murray Water
GVW	Goulburn Valley Water
MDBC	Murray Darling Basin Commission
OWOF	Our Water Our Future
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

1 Introduction

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 2008-2009 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 2008/09 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 2008/09;
- 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 2008/09 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 2008/09. 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.
- 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 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; and
- priority wetlands identified in Priority Wetlands in the Goulburn Broken Catchment (GB CMA 2006) and wetlands that received an environmental water allocation in May 2008.

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. In addition, expert advice concerning fish and flow management was obtained from the Arthur Rylah Institute.

1.7 2007-2008 Dry Inflow Contingency Plan

The 2007-2008 Goulburn Broken Catchment Dry Inflow Contingency Plan was completed in May 2007. A review of the Plan was undertaken in January 2008. The review indicated that of the 71 actions identified in the Plan, 52% were completed or partially completed, 16% did not commence and 32% were not required to be undertaken due to the scenario conditions not been met. Of the high priority actions 74% were completed or were partially completed, 10% did not commence and 16% were not required to be undertaken due to the scenario conditions not been met.

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

- 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 2006/07, 99% probability of exceedence inflow, 95% probability of exceedence inflow and 90% probability of exceedence inflow). The 2007-2008 Plan only considered three low flow scenarios (it did not include the 95% probability of exceedence inflow scenario).
- As a result of recent surveys and on-ground works, the Plan identifies a number of priority ecological values at new locations including:
 - Golden Perch in the Broken Creek;
 - Rigid Water-milfoil at Moodies and Kinnairds Swamps;
 - Murray Cod and Golden Perch in Lake Mokoan; and
 - Dwarf Flat-headed Gudgeon and Southern Pygmy Perch in Barmah Forest.
- The plan includes three additional wetlands (Kinnairds Swamp, Reedy Swamp and Black Swamp). These wetlands received environmental water allocations in May 2008 and are now providing critical refuge and habitat for aquatic dependent species in the Catchment. The maintenance of these habitats has been identified as a high priority action in this plan.

Figure 1 Goulburn Broken Catchment.



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 2008/09, 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 2008/09 are fish aquatic dependent amphibians, 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 (Tables 1-3).

Waterbirds are not considered to be at serious threat due to their mobility and capacity to utilize alternative aquatic environments including dams and sewerage ponds. Riparian and wetland vegetation communities are also not considered to be at serious threat due to their capacity to regenerate when favorable conditions are restored.

Table 1 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 2 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 ¹	<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 ²	<i>Philypnodon 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>Macquara 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 ³	<i>Nannoperca australis</i>				Riv/Wet

Table 2 (continued).

Common Name	Scientific Name	Conservation Status			Habitat
		EPBC	FFG	DSE	
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).



Figure 2 Left: Growling Grass Frog (Damien Cook Australian Ecosystems). Right: Murray Cod on the Broken Creek left (Justin O'Connor ARI).

Table 3 Flora species at most serious threat from no or low inflows.

Common Name	Scientific Name	Conservation Status			Habitat
		EPBC	FFG	DSE	
Amulla ¹	<i>Eremophila debilis</i>			EN	NA
Button Rush	<i>Lipocarpha 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
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
Moir 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

Table 3 (continued).

Common Name	Scientific Name	Conservation Status			Habitat
		EPBC	FFG	DSE	
Tangled Lignum	Muehlenbeckia florulenta				AMPH
Water-shield	Brasenia schreberi		L	VU	RWOA
Weeping Myall	Acacia pendula		L	EN	RO
Western Water-starwort	Callitriche cyclocarpa	VU		VU	AMPH
Yellow-tongue Daisy	Brachyscome chrysoglossa		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).

In addition, ecologically healthy rivers 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 2007/08.

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 2008/09 have been prioritised. 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 4). 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 5). A high priority ranking has been given to ecologically healthy rivers due to their conservation significance and the Dwarf Flat-headed Gudgeon and Southern Pygmy Perch, 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 6 lists the flora and fauna values in the Goulburn Broken Catchment considered at most serious threat from no or low inflows in 2007/08 and their priority ranking.

Table 4 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 5 Thresholds of high, medium and low priority.

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

Table 6 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 ²	<i>Philypnodon macrostomus</i>	NA	High
Macquarie Perch	<i>Macquara australasica</i>	9	High
Southern Pygmy Perch ³	<i>Nannoperca australis</i>	NA	High
Spotted Tree Frog	<i>Litoria spenceri</i>	8	High
Trout Cod	<i>Maccullochella macquariensis</i>	8	High
Carpet Python	<i>Morelia spilota metcalfei</i>	5	Medium
Damselfly	<i>Hemiphysbia mirabilis</i>	4	Medium
Dookie Daisy	<i>Brachyscome gracilis</i>	4	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
Growing Grass Frog	<i>Litoria raniformis</i>	6	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</i> subsp. <i>halmaturorum</i>	4	Medium
Silver Perch	<i>Bidyanus bidyanus</i>	6	Medium
Slender Club-sedge	<i>Isolepis congrua</i>	4	Medium
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
Yellow-tongue Daisy	<i>Brachyscome chrysoglossa</i>	4	Medium
Amulla#	<i>Eremophila debilis</i>	2	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
Coolibah Grass	<i>Panicum queenslandicum</i> var. <i>queenslandicum</i>	2	Low
Common Long-necked Turtle	<i>Chelodina longicollis</i>	0	Low
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	0	Low
Downs Nutgrass	<i>Cyperus bifax</i>	1	Low
Flat-headed Galaxias	<i>Galaxias rostratus</i>	3	Low
Flat Spike-sedge	<i>Eleocharis plana</i>	1	Low
Grey Billy-buttons	<i>Craspedia canens</i>	2	Low
Moir Grass	<i>Pseudoraphis spinescens</i>	0	Low
Murray-Darling Rainbowfish	<i>Melanotaenia fluviatilis</i>	3	Low
Murray Spiny Cray	<i>Euastacus armatus</i>	3	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
Slender Water-milfoil	<i>Myriophyllum gracile</i> var. <i>lineare</i>	2	Low
Sloane's Froglet	<i>Crinia sloanei</i>	0	Low

Table 6 (continued).

Common Name	Scientific Name	Accum. Score	Priority
Tangled Lignum	Muehlenbeckia florulenta	0	Low
Western Water-starwort	Callitriche cyclocarpa	2	Low



Figure 3 Left: Ridged Water-milfoil (Paul O'Connor DSE). Right: Watershield at Tahbilk Lagoon surround a small infestation of Yellow Water Lily (Fern Hames DSE).

2.3 Streams and Wetlands

In the Goulburn Broken Catchment a total of 5 regulated streams, 16 unregulated streams and 10 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 18 priority values at risk from no or low inflows (Figure 4). Of these priority values six are listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and 11 are listed under the Victorian Flora and Fauna Guarantee Act 1988. Table 7 lists these priority values and the streams in which they were recorded.

Table 7 Regulated streams that support or provide refuge for priority ecological values.

Stream	Reach	Ecological Value		Priority
		Common Name	Scientific Name	
Boosey Creek ¹	32	Coolibah Grass	<i>Panicum queenslandicum</i> var. <i>queenslandicum</i>	Low
	34	Growling Grass Frog	<i>Litoria raniformis</i>	Medium
	TBD	Pepper Grass	<i>Panicum laevinode</i>	Low
	34	Slender Club-sedge	<i>Isolepis congrua</i>	Medium
	32	Amulla#	<i>Eremophila debilis</i>	Low
Broken Creek	24	Golden Perch	<i>Macquaria ambigua</i>	Medium
	21 - 23	Murray Cod	<i>Maccullochella peelii peelii</i>	Medium
	22	Ridged Water-milfoil	<i>Myriophyllum porcatum</i>	Medium
	24	Slender Water-milfoil	<i>Myriophyllum gracile</i> var. <i>lineare</i>	Low
	TBD	Striped Water-milfoil	<i>Myriophyllum striatum</i>	Medium
	24	Yellow-tongue Daisy	<i>Brachyscome chrysoglossa</i>	Medium
Broken River	1-4	Golden Perch	<i>Macquaria ambigua</i>	Medium
	1-5	Murray-Darling rainbowfish	<i>Melanotaenia fluviatilis</i>	Low
	3 - 5	Macquarie Perch	<i>Macquaria australasica</i>	High
	1-5	Murray Cod	<i>Maccullochella peelii peelii</i>	Medium
	1	Silver Perch	<i>Bidyanus bidyanus</i>	Medium
	1-4	Trout Cod	<i>Maccullochella macquariensis</i>	High

Table 7 (continued).

Stream	Reach	Ecological Value		Priority
		Common Name	Scientific Name	
Goulburn River below Lake Eildon	4, 12	Brown Toadlet	<i>Pseudophryne bibronii</i>	Low
	1, 4, 6	Growing Grass Frog	<i>Litoria raniformis</i>	Medium
	1 - 8	Murray Cod	<i>Maccullochella peelii peelii</i>	Medium
	6	River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	Low
	1 - 8	Silver Perch	<i>Bidyanus bidyanus</i>	Medium
	9	Water-shield ²	<i>Brasenia schreberi</i>	Medium
	3	Western Water-starwort	<i>Callitriche cyclocarpa</i>	Low
Nine Mile Creek	29	Grey Billy-buttons	<i>Craspedia canens</i>	Low

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

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

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 the 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 12 priority values at risk from no or low inflows, including ecologically healthy river reaches (Figure 5). Of these priority values five are listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and 10 are listed under the Victorian Flora and Fauna Guarantee Act 1988. In addition, the unregulated Leary's (a tributary of Stevenson River) and Sunday Creeks support Barred Galaxias (Figure 5). 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 in Leary's and Sunday Creeks during summer in 2007 the Barred Galaxias populations were removed and kept in tanks at ARI. The Leary's Creek Barred Galaxias population was returned in winter 2008 and the Sunday Creek population is still being kept at ARI awaiting the return of suitable habitat. Table 8 lists these priority values and the streams in which they were recorded.

Table 8 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
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

Table 8 (continued).

Stream	Reach	Ecological Value		Priority
		Common Name	Scientific Name	
Hughes Creek	37	Macquarie Perch	Macquara australasica	High
	37	Murray Cod	Maccullochella peelii peelii	Medium
King Parrot Creek	51	Macquarie Perch	Macquara australasica	High
Leary's Creek	NA	Barred Galaxias	Galaxias fuscus	High
Rubicon River	66	Barred Galaxias	Galaxias fuscus	High
Ryans Creek	17	Ecologically healthy river		High
	16-17	Growing Grass Frog	Litoria raniformis	Medium
Seven Creeks	19-20	Macquarie Perch	Macquara australasica	High
	20	Murray Spiny Cray	Euastacus armatus	Low
	19	Trout Cod	Maccullochella macquariensis	High
Sunday Creek	NA	Barred Galaxias	Galaxias fuscus	High
Taggerty River	64	Barred Galaxias	Galaxias fuscus	High
	64	Ecologically healthy river		High
	64	Growing Grass Frog	Litoria raniformis	Medium
Sreavenson River	NA	Barred Galaxias	Galaxias fuscus	High
Yea River	54	Damselfly	Hemiphysalia mirabilis	Medium
	55	Macquarie Perch	Macquara australasica	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 the 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

A total of 149 priority wetlands have been identified in the Goulburn Broken Catchment according to their conservation significance and threats (GB CMA 2006). Of these wetlands 10 support or provide refuge to 32 priority values at risk from no or low inflows (Figure 6). Of these priority values seven are listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and 14 are listed under the Victorian Flora and Fauna Guarantee Act 1988. Table 9 lists these priority values, their conservation status and the wetlands in which they were recorded.

Table 9 Wetlands that support or provide refuge for priority ecological values.

Wetland	Status	Ecological Value		Priority
		Common Name	Scientific Name	
Barmah Forest	Ramsar Site	Barking Marsh Frog ¹	Limnodynastes fletcheri	Low
		Broad-shelled Turtle ²	Chelodina expansa	Low
		Brown Toadlet ¹	Pseudophryne bibronii	Low
		Button Rush	Lipocarpha microcephala	Low
		Common Long-necked Turtle ²	Chelodina longicollis	Low
		Common Spadefoot Toad ¹	Neobatrachus sudelli	Low
		Downs Nutgrass	Cyperus bifax	Low
		Dwarf Flat-headed Gudgeon ¹	Phlypnodon macrostomus	High
		Flat-headed Galaxias	Galaxias rostratus	Low
		Freshwater Catfish	Tandanus tandanus	Medium

Table 9 (continued).

Wetland	Status	Ecological Value		Priority
		Common Name	Scientific Name	
Barmah Forest	Ramsar Site	Giant Bullfrog ⁴	<i>Limnodynastes interioris</i>	Medium
		Golden Perch ³	<i>Macquaria ambigua</i>	Medium
		Growling Grass Frog ⁴	<i>Litoria raniformis</i>	Medium
		Macquarie Perch	<i>Macquara australasica</i>	High
		Moir Grass ⁵	<i>Pseudoraphis spinescens</i>	Low
		Mueller Daisy	<i>Brachyscome muelleroides</i>	High
		Murray Cod ³	<i>Maccullochella peelii peelii</i>	Medium
		Murray Spiny Cray	<i>Euastacus armatus</i>	Low
		Murray-Darling Rainbowfish ³	<i>Melanotaenia fluviatilis</i>	Low
		River Blackfish	<i>Gadopsis marmoratus</i>	Low
		River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	Low
		Silver Perch ³	<i>Bidyanus bidyanus</i>	Medium
		Sloane's Froglet ¹	<i>Crinia sloanei</i>	Low
		Southern Pygmy Perch ¹	<i>Nannoperca australis</i>	High
		Swamp Yabby ⁶	<i>Cherax rotundas</i>	Low
		Trout Cod	<i>Maccullochella macquariensis</i>	High
		Yellow-tongue Daisy	<i>Brachyscome chrysoglossa</i>	Medium
Black Swamp	WOBS	River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	Low
Chinamans Lagoon	WOBS	Broad-shelled Turtle	<i>Chelodina expansa</i>	Low
Greens Swamp	WOBS	Ridged Water-milfoil	<i>Myriophyllum porcatum</i>	Medium
		Western Water-starwort	<i>Callitriche cyclocarpa</i>	Low
Kanyapella Basin	WONS	River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	Low
Kinnairds Swamp ⁷	NA	Ridged Water-milfoil	<i>Myriophyllum porcatum</i>	Medium
Lake Mulwala	WOBS	Trout Cod	<i>Maccullochella macquariensis</i>	High
Lake Mokoan	WOBS	Golden Perch	<i>Macquaria ambigua</i>	Medium
		Growling Grass Frog	<i>Litoria raniformis</i>	Medium
		Murray Cod	<i>Maccullochella peelii peelii</i>	Medium
Moodies Swamp	WONS	Ridged Water-milfoil	<i>Myriophyllum porcatum</i>	Medium
Tahbilk Lagoon	WOBS	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
Wallenjow Wetlands	WOBS	Cane Grass	<i>Eragrostis australasica</i>	Low
		Salt Paperbark	<i>Melaleuca halmaturorum</i> subsp. <i>halmaturorum</i>	Medium

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.

7 Not a priority wetland but included in the development of the plan as it recently received an environmental water allocation and is providing important aquatic habitat (section 3.3).

3 In-flow Scenarios

With the dry conditions in 2007/08, 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 2007/08. This means that in 2008/09, 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 2007/2008 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 2008/09 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 2008/09 season under the four low inflow scenarios.

The four low inflow scenarios for the 2008/09 season assume that 2007/08 stays dry until June 2008. In addition, each stream and wetland is considered in isolation when describing its likely operation, environmental condition and impact on priority values in the 2008/09 season under the four low inflow scenarios.

3.1 Regulated Streams

3.3.1 Broken and Boosey Creeks upstream of Katamatite Township

Operation during 2007/2008:

- 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 71% of licensed volume.

Environmental conditions during 2007/2008:

- 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.
- No water quality issues were identified.

Operation under the 2006/2007 Inflow Scenario:

- No flow is expected in the Broken Creek throughout the year.
- No flow is expected in the Boosey Creek throughout the year.
- No irrigation allocation will be available on the Broken Creek below Casey's Weir.

Environmental conditions under the 2006/2007 Inflow Scenario:

- Habitats within the Broken Creek channel will be reduced to a series of isolated pools that may dry out in summer.
- Habitats within the Boosey Creek channel will be reduced to a series of isolated pools that may dry out in summer.
- Freshes and high flow events will not occur.
- Pools in the Broken and Boosey Creeks will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.
- 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.

Operation under the 99% Probability of Exceedence Inflow Scenario:

- No flow is expected in the Broken Creek throughout the year.
- No flow is expected in the Boosey Creek throughout the year.
- No irrigation allocation will be available on the Broken Creek below Casey's Weir.

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

- Habitats within the Broken Creek channel will be reduced to a series of isolated pools that may dry out in summer.
- Habitats within the Boosey Creek channel will be reduced to a series of isolated pools that may dry out in summer.
- Freshes and high flow events will not occur.
- Pools in the Broken and Boosey Creeks will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.
- 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.

Operation under the 95% Probability of Exceedence Inflow Scenario:

- Flow in the Broken Creek below Casey's Weir will be approximately 1 ML/day.
- No flow is expected in the Broken Creek below Waggarandal Weir throughout the year.
- No flow is expected in the Boosey Creek throughout the year.
- No irrigation allocation will be available on the Broken Creek below Casey's Weir. However, there will be restricted domestic and stock allocations supplied.

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

- Habitats within the Broken Creek channel below Casey's Weir will be reduced to a series of isolated pools connected by very low flows.
- Habitats within the Broken Creek channel between Waggarandal Weir and Katamatite Township will be reduced to a series of isolated pools that may dry out in summer.
- Habitats within the Boosey Creek channel will be reduced to a series of isolated pools that may dry out in summer.
- Freshes and high flow events will not occur.
- Pools in the Broken and Boosey Creeks will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.
- No flow in the Broken Creek below Waggarandal Weir during summer is consistent with its environmental flow recommendations and on going management.

Operation under the 90% Probability of Exceedence Inflow Scenario:

- Flow in the Broken Creek below Casey's Weir will be approximately 5 ML/day.
- No flow is expected in the Broken Creek below Waggarandal Weir throughout the year.
- No flow is expected in the Boosey Creek throughout the year.
- The irrigation allocation on the Broken Creek below Casey's Weir will be 10% of licensed volume.

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

- Habitats within the Broken Creek channel will be connected below Casey's Weir.
- Habitats within the Broken Creek channel between Waggarandal Weir and Katamatite Township will be reduced to a series of isolated pools that may dry out in summer.
- Habitats within the Boosey Creek channel will be reduced to a series of isolated pools that may dry out in summer.
- Pools in the Broken and Boosey Creeks will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.
- Freshes may occur and high flow events will not occur.
- No flow in the Broken Creek below Waggarandal Weir during summer is consistent with its environmental flow recommendations and on going management.

3.3.2 Broken and Nine Mile Creeks downstream of Katamatite

Operation during 2007/2008:

- 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 45% of licensed volume (Murray allocation).

Environmental conditions during 2007/2008:

- Habitats within the channel were connected.
- As in previous years Azolla blooms occurred between Nathalia and Rice's Weir between August and November 2007.
- 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.

Operation under the 2006/2007 Inflow Scenario:

- No water supplied to the Broken Creek from the Goulburn River system.
- No flow is expected along the system throughout the year.
- Numurkah and Nathalia weir pools maintained for urban use. No other water supply needs will be met.
- Fish ladders will not operate.

Environmental conditions under the 2006/2007 Inflow Scenario:

- 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.
- Freshes and high flow events will not occur.
- 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.
- Exposed aquatic weeds may be readily controlled or eradicated.
- Loss of riparian vegetation and habitat.

Operation under the 99% Probability of Exceedence Inflow Scenario:

- No water supplied to the Broken Creek from the Goulburn River system.
- No flow is expected along the system throughout the year.
- Numurkah and Nathalia weir pools maintained for urban use. No other water supply needs will be met.
- Fish ladders will not operate.

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

- 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.
- Freshes and high flow events will not occur.
- 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.
- Exposed aquatic weeds may be readily controlled or eradicated.
- Loss of riparian vegetation and habitat.

Operation under the 95% Probability of Exceedence Inflow Scenario:

- Low flow is expected in the Broken and Nine Mile Creeks throughout the year.
- Near normal storage in weir pools.
- Fish ladders may operate if Murray and Goulburn water redirected through the Creeks.
- An irrigation allocation of approximately 20% of licensed volume will be available.

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

- Throughout the year most habitats within the channel will be connected by low flows.
- Freshes may occur and high flow events will not occur.
- Pools are at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.
- Exposed aquatic weeds may be readily controlled or eradicated.
- Loss of riparian vegetation and habitat.

Operation under the 90% Probability of Exceedence Inflow Scenario:

- Low flow is expected in the Broken and Nine Mile Creeks throughout the year.
- Near normal storage in weir pools.
- Fish ladders may operate if Murray and Goulburn water redirected through the Creeks.
- An irrigation allocation of approximately 50% of licensed volume will be available.

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

- Throughout the year all habitats within the channel will be connected by low flows.
- Freshes may occur and high flow events will not occur.
- Pools are at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.
- Exposed aquatic weeds may be readily controlled or eradicated.
- Loss of riparian vegetation and habitat.



Figure 7 Left: Nine Mile Creek September 2008 (Mark Turner GB CMA). Right: Azolla bloom in the lower Broken Creek 2007 (Keith Ward GB CMA).

3.3.3 Broken River

Operation during 2007/2008:

- Flow was approximately 15-20 ML/day between Lake Nillahcootie and Casey's Weir and 50 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 71% of licensed volume.
- Fish ladders were operating (Casey's Weir and Benalla Weir).

Environmental conditions during 2007/2008:

- Habitats within the Broken River channel were connected.
- 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 were identified.

Operation under the 2006/2007 Inflow Scenario:

- No flow is expected throughout the year between Lake Nillahcootie and the Goulburn River.
- Fish ladders will not operate (Casey's Weir and Benalla Weir).
- No irrigation allocation will be available.
- Domestic and stock water will be carted.

Environmental conditions under the 2006/2007 Inflow Scenario:

- Habitats within the Broken River channel will be reduced to a series of isolated pools. Smaller pools may dry out in summer.
- Pools will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.
- Freshes and high flow events will not occur.
- Exposed aquatic weeds may be readily controlled or eradicated.
- Loss of riparian vegetation and habitat.

Operation under the 99% Probability of Exceedence Inflow Scenario:

- No flow is expected throughout the year between Lake Nillahcootie and the Goulburn River.
- Fish ladders will not operate (Casey's Weir and Benalla Weir).
- No irrigation allocation will be available.
- Domestic and stock water will be carted.

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

- Habitats within the Broken River channel will be reduced to a series of isolated pools. Smaller pools may dry out in summer.
- Pools will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.
- Freshes and high flow events will not occur.
- Exposed aquatic weeds may be readily controlled or eradicated.
- Loss of riparian vegetation and habitat.

Operation under the 95% Probability of Exceedence Inflow Scenario:

- Regulated river operation is possible for 7 days per month at low rates.
- No irrigation allocation will be available. Essential domestic and stock allocations will be supplied
- Fish ladders may operate 7 days per month (Casey's Weir and Benalla Weir) depending of flow.

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

- Habitats within the Broken River channel will be reduced to a series of isolated pools connected only during river operation.
- Pools will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.
- Reduced frequency and duration of freshes.
- High flow events are not expected.
- Increased shallow water habitat favoured by in-channel macrophytes and small fish.

Operation under the 90% Probability of Exceedence Inflow Scenario:

- Regulated river operation is possible for 14 days per month at low rates.
- An irrigation allocation of approximately 10% of licensed volume will be available.
- Fish ladders will operate 14 days per month (Casey's Weir and Benalla Weir).

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

- Habitats within the Broken River channel will be reduced to a series of isolated pools connected only during river operation.
- Pools will be at risk of low dissolved oxygen levels, algal and Azolla blooms which may result in fish deaths.
- Reduced frequency and duration of freshes.
- High flow events are not expected.
- Increased shallow water habitat favoured by in-channel macrophytes and small fish.

3.3.4 Goulburn River (Lake Eildon to the Murray River)

Operation during 2007/2008:

- 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 was at 96% of its full supply level.
- Waranga Basin operated between 29% and 31% full to the end of January 2007. It was then pumped down to 38 GL or 9% of its full supply level, which was reached in May 2008.
- Greens Lake was 87% full and was pumped back to 25% full by the end of May 2008.
- The irrigation allocation was 57% 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 2007/2008:

- 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 14-17°C in November to 19-22°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.

Operation under the 2006/2007 Inflow Scenario:

- Throughout the year flow is expected to be approximately 500 ML/day between Lake Eildon and the Goulburn Weir.
- Throughout the year flow is expected to be approximately 300 ML/day between the Goulburn Weir and the Murray River. This is approximately half the recommended minimum flow for this section of river and less than the Bulk Entitlement minimum flow (Cottingham et. al. 2003).
- The Goulburn Weir may be lowered to approximately 90% of its full supply level.
- Waranga Basin and Greens Lake are drawn down to near empty to provide additional water for consumptive use.
- 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.
- Urban centres will receive restricted allocations. Towns supplied by channels will require water to be maintained in weir pools and refilled occasionally.
- Water will not be available for horticulture except by carryover.
- No water supplied to the Broken Creek system.
- 20 GL available for water quality management in the lower Goulburn River (see Appendix 1). May be used to manage water quality in the lower Broken Creek if it is not required in the lower Goulburn River.

Environmental conditions under the 2006/2007 Inflow Scenario:

- Freshes are not expected below the Goulburn Weir. Some winter and spring freshes above the Goulburn Weir are expected.
- High flow events are not expected.
- Limited connectivity will be maintained between habitats within the Goulburn River channel throughout the year between Lake Eildon and the Goulburn Weir.
- Limited connectivity will be maintained between habitats within the Goulburn River channel throughout the year between the Goulburn Weir and the Murray River.
- Increased shallow water habitat favoured by in-channel macrophytes and small fish.
- Elevated water temperatures and low dissolved oxygen levels are a risk and may impact on native aquatic fauna.
- Water temperatures below Lake Eildon may be higher than normal and may not support Trout.
- Loss of riparian vegetation and habitat.
- Exposed aquatic weeds may be readily controlled or eradicated.

Operation under the 99% Probability of Exceedence Inflow Scenario:

- Flow is expected to be approximately 1000 ML/day between Lake Eildon and the Goulburn Weir throughout the year.
- Flow is expected to be approximately 300 ML/day between the Goulburn Weir and the Murray River throughout the year. This is below the recommended minimum flow for this section of river and meets the Bulk Entitlement minimum flow (Cottingham et. al. 2003).
- The Goulburn Weir may be lowered to approximately 90% of its full supply level.
- Waranga Basin and Greens Lake are drawn down to near empty to provide additional water for consumptive use.
- Urban centres will receive restricted allocations. Towns supplied by channels will require water to be maintained in weir pools and refilled occasionally.
- Water will not be available for horticulture except by carryover.
- No irrigation allocation will be available except for carryover. Some channels may operate and all channels that supply towns will operate.
- 20 GL available for water quality management in the lower Goulburn River (see Appendix 1). May be used to manage water quality in the lower Broken Creek if it is not required in the lower Goulburn River.

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

- Reduced frequency and duration of freshes between Lake Eildon and the Murray River.
- High flows are not expected.
- Connectivity between habitats within the channel will be maintained throughout the year between Lake Eildon and the Goulburn Weir.
- Connectivity between habitats within the channel will be maintained throughout the year between the Goulburn Weir and the Murray River.
- Increased shallow water habitat favoured by in-channel macrophytes and small fish.
- Elevated water temperatures and low dissolved oxygen levels are a risk and may impact on native aquatic fauna.
- Water temperatures below Lake Eildon may be higher than normal and may not support Trout.
- Loss of riparian vegetation and habitat.
- Exposed aquatic weeds may be readily controlled or eradicated.

Operation under the 95% Probability of Exceedence Inflow Scenario:

- Flow is expected to be approximately 1500 ML/day between Lake Eildon and the Goulburn Weir throughout the year.
- Flow is expected to be approximately 400 ML/day between the Goulburn Weir and the Murray River throughout the year. This is below the recommended minimum flow for this section of river and meets the Bulk Entitlement minimum flow (Cottingham et. al. 2003). Higher summer flows are possible due to inter valley transfers.
- The Goulburn Weir will operate at near normal supply level.
- Waranga Basin will be pumped down to 38 GL or 9% of its full supply level to provide additional water for consumptive use.
- Urban centres may receive restricted allocations.
- The irrigation allocation will be approximately 20% of water rights and licensed volume. Most channels will operate.
- 20 GL available for water quality management in the lower Goulburn River (see Appendix 1). May be used to manage water quality in the lower Broken Creek if it is not required in the lower Goulburn River.

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

- Reduced frequency and duration of freshes between Lake Eildon and the Murray River.
- High flows are not expected.
- Connectivity between habitats within the channel will be maintained throughout the year between Lake Eildon and the Goulburn Weir.
- Connectivity between habitats within the channel will be maintained throughout the year between the Goulburn Weir and the Murray River.
- Elevated water temperatures and low dissolved oxygen levels are a risk and may impact on native aquatic fauna.
- Water temperatures below Lake Eildon may be higher than normal and may not support Trout.
- Loss of riparian vegetation and habitat.
- Exposed aquatic weeds may be readily controlled or eradicated.

Operation under the 90% Probability of Exceedence Inflow Scenario:

- Flow is expected to be between 3000 – 4000 ML/day between Lake Eildon and the Goulburn Weir in spring, summer and autumn.
- Flow is expected to be between 100-5000 ML/day between Lake Eildon and the Goulburn Weir in winter.
- Flow is expected to be approximately 400 ML/day between the Goulburn Weir and the Murray River throughout the year. This is below the recommended minimum flow for this section of river and meets the Bulk Entitlement minimum flow (Cottingham et. al. 2003). Higher summer flows are possible due to inter valley transfers.
- The Goulburn Weir will operate at near normal supply level.
- Waranga Basin will be pumped down to 38 GL or 9% of its full supply level to provide additional water for consumptive use.
- Greens Lake may operate normally.
- The irrigation allocation will be approximately 48% of water rights and licensed volume. Channels may operate normally.

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

- Reduced frequency and duration of freshes between Lake Eildon and the Murray River.
- 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.
- Connectivity between habitats within the Goulburn River channel will be maintained throughout the year between Lake Eildon and the Goulburn Weir.
- Connectivity between habitats within the Goulburn River channel will be maintained throughout the year between the Goulburn Weir and the Murray River.
- Water temperatures below Lake Eildon may be higher than normal and may not support Trout.

3.2 Unregulated Streams

The flow status in the 2007-2008 season, system operation and likely flow status under the four inflow scenarios of the unregulated streams are summarised below in Table 10.

Table 10 2007-2008 season flow status, system operation and likely flow status under the three inflow scenarios of unregulated streams that support or provide refuge for priority ecological values.

Stream	Reach	Provides Urban Water Supply	Current Flow Status	Current System Operation	Inflow Scenarios			
					2006/2007 Inflow	99% ile Inflow	95% ile Inflow	90% ile Inflow
Acheron River	62	No	LF		LF	LF	LF	NNF
	63	No	LF		LF	LF	LF	NNF
Big River	67	No	LF		LF	LF	LF	NNF
	68	No	LF		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	LF - NF2	IS	LF - NF2	LF	LF	NNF
	14	No	LF - NF2	IS	LF - NF2	LF	LF	NNF
	15	No	LF	IS	LF	LF	LF	NNF
Howqua River	69	No	LF - NF2		LF - NF2	LF	LF	NNF
	70	No	LF		LF	LF	LF	NNF
Hughes Creek	37	No	NF1		NF 1	LF	LF	NNF
	38	No	LF		LF	LF	LF	NNF
	39	No	LF		LF	LF	LF	NNF
King Parrot Creek	51	Yes	LF - NF2		LF - NF2	LF	LF	NNF
	52	Yes	LF		LF	LF	LF	NNF
Leary's Creek	NA	No	NF1 - NF2		NF1 - NF2	LF	LF	NNF
Rubicon River	65	No	LF		LF	LF	LF	NNF
	66	No	LF		LF	LF	LF	NNF
Ryans Creek	16	Yes	TBD		LF	LF	LF	NNF
	17	Yes	TBD		LF	LF	LF	NNF
Seven Creeks	17	Yes	NF2		NF2	LF	LF	NNF
	18	Yes	NF2		NF2	LF	LF	NNF
	19	Yes	LF - NF2		LF - NF2	LF	LF	NNF
	20	Yes	LF		LF	LF	LF	NNF
Steavenson River	NA	No	LF		LF	LF	LF	NNF
Sunday Creek	NA	No	NF1 - NF2	IS	NF1 - 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

Environmental conditions during 2007-2008:

- In stream habitats were connected in the majority of priority unregulated streams.
- No significant water quality issues were identified.

Environmental conditions under the 2006/2007 Inflow Scenario:

- In stream habitats will be connected in the majority of priority unregulated streams.
- Freshes and high flow events will not occur.
- Hughes Creek, King Parrot Creek and Seven Creeks catchments not affected by the recent fires will be at risk of wildfire in summer (Figure 8).

- 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.
- Reduced frequency and duration of freshes.
- High flows will not occur.
- Hughes Creek, King Parrot Creek and Seven Creeks catchments not affected by the recent fires will be at risk of wildfire in summer.
- Significant water quality issues are not expected.

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

- In stream habitats will be connected.
- Reduced frequency and duration of freshes.
- High flow events will not occur.
- Hughes Creek, King Parrot Creek and Seven Creeks catchments not affected by the recent fires will be at risk of wildfire in summer.
- Significant water quality issues are not expected.

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

- In stream habitats will be connected.
- Reduced frequency and duration of freshes and high flow events.
- 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.



Figure 9 Left: Upper Goulburn River 2008 (Water Technology). Right: King Parrot Creek 2008 (Water Technology).

3.3 Wetlands

Operation:

Of the wetlands that support or provide refuge for priority ecological values only Lake Mokoan and Lake Mulwala are used as active water storages.

In 2004 as part of the Our Water Our Future action plan, the Victorian Government announced it would decommission Lake Mokoan and rehabilitate the original wetland complex and associated terrestrial land. The decommissioning of Lake Mokoan is expected to save 44,000 megalitres of water annually, which will be used to improve environmental flows for the Snowy and Murray rivers. It is anticipated that Lake Mokoan will be decommissioned in July 2009. Until that time, Lake Mokoan will remain an active water storage and managed to provide water for irrigation, domestic and stock use. The water level of the Lake is currently at 6% of its full supply level and may be fully drawn down by January 2009 to help meet G-MW's water supply obligations and keep the Broken River running at low levels.

The water level at Lake Mulwala is currently 85% of the full supply level and is unlikely to significantly change under the four inflow scenarios.

Environmental Conditions:

Four of the 11 wetlands identified in section 2.2.3 are currently dry and are unlikely to receive water under the four inflow scenarios unless an environmental water allocation is provided (Table 11). In their current dry state these wetlands provide limited or no habitat for aquatic dependent flora and fauna. In addition, 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 no longer be supported by these wetlands.

The Department of Sustainability and Environment in April approved the use of 17 gigalitres (GL) of water to inundate a number of stressed wetlands in northern Victoria. In May over 1000 megalitres of environmental water was delivered to:

- Reedy Swamp (544 megalitres);
- Black Swamp (90 megalitres); and
- Kinnairds Swamp (413 megalitres).

In addition, 50 megalitres of surplus irrigation flows in the Broken Creek were opportunistically diverted to Moodies Swamp. The environmental water was delivered to Reedy Swamp, Kinnairds Swamp and Moodies Swamp via irrigation drains and channels. The environmental water was directly pumped from the Nine Mile Creek into Black Swamp due to low flows.

The environmental water has stimulated the growth and germination of aquatic plants and attracted a variety of frogs and water birds including the threatened Freckled Duck, Australian Shoveller, White bellied Sea-eagle, Perigeon Falcon, Musk Duck, Hardhead and Brolga. Swans have successfully breed at Reedy Swamp and a number of other water bird species are exhibiting breeding and courtship behaviour including Swamp Harriers and Brolga at Moodies Swamp. Colonial nesting bird species including Ibis and Spoonbill are expected to start breeding at Reedy Swamp and Black Swamp in the coming weeks.



Figure 10 Left: Pair of Brolga at Kinnairds Swamp 2008 (Paul O'Connor DSE). Right: Signet at Reedy Swamp 2008 (Paul O'Connor DSE).

Reedy Swamp, Black Swamp, Kinnairds Swamp and Moodies Swamp are currently the only significant ephemeral wetlands in the catchment holding water and are therefore providing important breeding and feeding habitat for wetland dependent species, particularly amphibians and waterbirds.

Currently the main body of Tahbilk Lagoon is close to its full supply level and provides suitable habitat for aquatic dependent flora and fauna. However, water in the shallow arms of the Lagoon has receded and in some cases dried. Under the four inflow scenarios the aquatic habitats of Tahbilk Lagoon are expected to be maintained.

The water level of Lake Mokoan in December 2007 was approximately 10% of the full supply level. It has since declined to its current level of 6% of the full supply level (the full supply level of the original wetland system is approximately 8%) and it is expected to be completely drawn down by January 2009. To avoid potential fish deaths the Department of Sustainability and Environment is planning to translocate Murray Cod and Golden Perch from Lake Mokoan to local waterways in November 2008. Other measures to minimise the potential impacts on the current and desired future environmental values of Lake Mokoan during its final drawdown and decommissioning are being investigated by the Department of Sustainability and Environment, Goulburn-Murray Water and the Goulburn Broken Catchment Management Authority.

The aquatic habitat values of Lake Mulwala have not been significantly impacted on under the current inflow conditions and are unlikely to change under the four inflow scenarios.

Table 11 Current and likely environmental condition under the three inflow scenarios of the wetlands that support or provide refuge for priority ecological values.

Wetland & Status	Environmental Condition					Year last inundated	Required Flooding Frequency
	Current	2006/2007 Inflow	99%ile Inflow	95%ile Inflow	90%ile Inflow		
Barmah Forest	Dry ¹	Dry	Dry	Dry	Dry	2005	Near annual
Black Swamp	80% of FSL	Dry by Dec.	Dry by Dec.	Dry by Dec.	Dry by Dec.	2006	Near annual
Chinamans Lagoon	50% of FSL	50% of FSL	50% of FSL	50% of FSL	50% of FSL	NA	NA
Greens Swamp	Dry	Dry	Dry	Dry	Dry	1993	Near annual
Kanyapella Basin	Dry	Dry	Dry	Dry	Dry	1993	Near annual
Kinnairds Swamp	25% of FSL	Dry by Dec.	Dry by Dec.	Dry by Dec.	Dry by Dec.	2005	Near annual
Lake Mulwala	85% of FSL	93% of FSL	93% of FSL	93% of FSL	93% of FSL	NA	NA
Lake Mokoan	6% of FSL	Dry by Dec.	Dry by Dec.	Dry by Dec.	Dry by Dec.	NA	NA
Moodies Swamp	20% of FSL	Dry by Dec.	Dry by Dec.	Dry by Dec.	Dry by Dec.	1996	Near annual
Reedy Swamp	60%	Dry by Dec.	Dry by Dec.	Dry by Dec.	Dry by Dec.	2006	Near annual
Tahbilk Lagoon	95% of FSL	95% of FSL	95% of FSL	95% of FSL	100% of FSL	NA	Permanent
Wallenjoe Wetland	Dry	Dry	Dry	Dry	Dry	1993	Near annual

1 A number of internal creeks still hold small residual volumes of water in deep pools and are providing habitat for turtles and native fish including the Dwarf Flat-headed Gudgeon and Southern Pygmy Perch, which are high priority ecological values. The pools are likely to dry out in summer unless an environmental water allocation is provided.



Figure 11 Left: Smiths Creek Barmah Forest 2007 (Keith Ward GB CMA). Right: Lake Mokoan 2008 (Keith Ward GB CMA).

4 Risk Management Priorities

To help establish management priorities, the likelihood and consequence of the major threat types habitat loss and reduced water quality (Appendix 2), 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 12). 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 13). Tables 14-16 list the priority values within each stream and wetland 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 largely native fish species including Barred Galaxias, Macquarie Perch, Murray Cod, Trout Cod, Dwarf Flat-headed Gudgeon, Southern Pygmy Perch and Silver Perch in the Goulburn River, Broken Creek, a number of unregulated streams and Barmah Forest.

Table 12 Impact rating criteria.

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

Table 13 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

Table 14 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	Low	Low	Low	Low	Low	Low	Low
	32	Amulla	Low	Low	Low	Low	Low	Low	Low	Low	Low
Broken Creek	24	Golden Perch	Medium	High	High	High	High	Medium	Medium	Medium	Medium
	21 - 23	Murray Cod	Medium	High	High	High	High	Medium	Medium	Medium	Medium
	22	Ridged Water-milfoil	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	24	Slender Water-milfoil	Low	Low	Low	Low	Low	Low	Low	Low	Low
	TBD	Striped Water-milfoil	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	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	Medium	Medium
	1-5	Murray- Darling rainbowfish	Low	High	High	High	High	High	High	Medium	Medium
	3 - 5	Macquarie Perch	High	High	High	High	High	High	High	Medium	Medium
	1-5	Murray Cod	Medium	High	High	High	High	High	High	Medium	Medium
	1	Silver Perch	Medium	High	High	High	High	High	High	Medium	Medium
	1-4	Trout Cod	High	High	High	High	High	High	High	Medium	Medium
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	Low	Low	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	Low	Low	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

Table 15 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	Low	Low	Low	Low	Low	Low	Low	Low
	63	Murray Spiny Cray	Low	Low	Low	Low	Low	Low	Low	Low	Low
Big River	68	Ecologically healthy river	High	Low	Low	Low	Low	Low	Low	Low	Low
	67	Spotted Tree Frog	High	Low	Low	Low	Low	Low	Low	Low	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	Ecologically 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 ¹	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 ¹	51	Macquarie Perch	High	High	High	Low	Low	Low	Low	Low	Low
Leary's Creek	NA	Barred Galaxias	High	High	High	Low	Low	Low	Low	Low	Low
Rubicon River	66	Barred Galaxias	High	Low	Low	Low	Low	Low	Low	Low	Low
Ryans Creek	17	Ecologically 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 ¹	19-20	Macquarie Perch	High	High	High	Low	Low	Low	Low	Low	Low
	20	Murray Spiny Cray	Low	Low	Low	Low	Low	Low	Low	Low	Low
	19	Trout Cod	High	High	High	Low	Low	Low	Low	Low	Low

Table 15 (continued).

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
Steavenson River	NA	Barred Galaxias	High	Low	Low	Low	Low	Low	Low	Low	Low
Sunday Creek	NA	Barred Galaxias	High	High	High	Low	Low	Low	Low	Low	Low
Taggerty River	64	Barred Galaxias	High	Low	Low	Low	Low	Low	Low	Low	Low
	64	Ecologically healthy river	High	Low	Low	Low	Low	Low	Low	Low	Low
	64	Growling Grass Frog	Medium	Low	Low	Low	Low	Low	Low	Low	Low
Yea River	54	Damselfly	Medium	Low	Low	Low	Low	Low	Low	Low	Low
	55	Macquarie Perch	High	Low	Low	Low	Low	Low	Low	Low	Low

1 The catchments of the Hughes Creek, King Parrot Creek and Seven Creeks are at risk of wildfire under the 2006/2007 and 99% probability of exceedence inflow scenarios. If a wildfire occurs in these catchments the risk rating for reduced water quality and habitat loss would become high for these streams due to the risk of ash and sediment washing into them.

Table 16 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

Table 16 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	Macquarie Perch	High	Low	Low	Low	Low	Low	Low	Low	Low
	Moirra 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
Chinamans Lagoon	Broad-shelled Turtle	Low	Low	Low	Low	Low	Low	Low	Low	Low
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
Lake Mulwala	Trout Cod	High	Low	Low	Low	Low	Low	Low	Low	Low
Lake Mokoan	Golden Perch	Medium	High	High	High	High	High	High	High	High
	Growling Grass Frog	Medium	High	High	High	High	High	High	High	High
	Murray Cod	Medium	High	High	High	High	High	High	High	High
Moodies Swamp	Ridged Water-milfoil	Medium	Low	Low	Low	Low	Low	Low	Low	Low

Table 16 (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
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
Wallenjoie Wetlands	Cane Grass	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Salt Paperbark	Medium	Low	Low	Low	Low	Low	Low	Low	Low

5 Management Actions

The following 74 actions address the management objectives and the risk management priorities at a total cost of \$1,167,800. 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 and wetlands 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	Use the Goulburn Water Quality allowance to run 250 ML/day during winter 2008 for water quality and environmental flow management.	Maintain aquatic habitat and water quality	Murray Cod, Silver Perch	GB CMA Board, G-MW, DSE	June 2008	NA	NA	High
2	Goulburn Weir - Murray River (reaches 1-8)	i, ii, iii, v, vi	Monitor water quality and flow (includes the installation of multilevel water quality probes at two locations downstream of Shepparton).	Inform management decisions	Murray Cod, Silver Perch	G-MW, DSE	Dec 2008	\$50,000	7GL	Medium
3	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 and autumn 2008	\$90,200	VEFMAP	Medium

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

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
4	Goulburn Weir - Murray River (reaches 1-8)	i, ii, iii, v	Survey the abundance and diversity fish, fish eggs and fish larvae (ARI implementing).	Inform management decisions	Murray Cod, Silver Perch	G-MW, DSE	Spring and autumn 2008	\$76,000	Goulburn LSRR	Medium
5	Goulburn Weir	i, ii, iii, v, vi	Monitor water quality and flow (G-MW implementing). Develop management responses for poor water quality.	Inform management decisions	Murray Cod, Silver Perch	GB CMA	Ongoing	NA	NA	Medium

Goulburn River (95% and 90% Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
6	Goulburn Weir - Murray River (reaches 1-8)	i, ii, iii, v, vi	Monitor water quality and flow (includes the installation of multilevel water quality probes at two locations downstream of Shepparton).	Inform management decisions	Murray Cod, Silver Perch	G-MW, DSE	Dec 2008	\$50,000	7GL	Low
7	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 and autumn 2008	\$90,200	VEFMAP	Low
8	Goulburn Weir - Murray River (reaches 1-8)	i, ii, iii, v	Survey the abundance and diversity fish, fish eggs and fish larvae (ARI implementing).	Inform management decisions	Murray Cod, Silver Perch	G-MW, DSE	Spring and autumn 2008	\$76,000	Goulburn LSRR	Low
9	Goulburn Weir	i, ii, iii, v, vi	Monitor water quality and flow (G-MW implementing). Develop management responses for poor water quality.	Inform management decisions	Murray Cod, Silver Perch	GB CMA	Ongoing	NA	NA	Low

Broken River (All Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
10	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
11	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 and autumn 2008	\$15,000	RCIP	High

Broken River (All Scenarios continued)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
12	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 and autumn 2008	\$90,200	VEFMAP	High

Broken and Boosey Creeks (All Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
13	Broken Creek Nathalia to the Murray River (reaches 21-23)	i, ii, iii, v, vi, vii	Run 80-100ML/day of Goulburn River Water and flushes down the creek to: <ul style="list-style-type: none"> maintain water quality; maintain fish habitat; and to operate the fish ladders. Requires use of the Goulburn River Water Quality allocation to offset any losses (approximately 10GL).	Maintain aquatic habitat and water quality	Murray Cod	G-MW, DSE	Spring and summer 2008-2009	NA	NA	High
14	Broken Creek Nathalia to the Murray River (reaches 21-23)	i, ii, iii, v, vii	Monitor fish movement upstream and downstream of weir pools (via PIT Tag readers) in response to flow regimes (ARI implementing).	Inform management decisions	Murray Cod	G-MW, DSE	Ongoing	\$15,000	10GL	High
15	Broken Creek Rices Weir (reach 21)	i, ii, iii, v, vi, vii	Monitor water quality in Rices Weir pool (includes the installation of multilevel water quality probes and a weather station).	Inform management decisions	Murray Cod	G-MW, DSE	Spring and summer 2008-2009	\$50,000	7GL	High
16	Broken Creek Katamatite - Waggarandall Weir (reaches 25-26) Boosey Creek Katamatite - Tungamah (reach 33)	i, ii, iii, v, vii	Deepen exiting habitat pools (6 pools on the Broken Creek and 3 pools on the Boosey Creek).	Maintain aquatic habitat and water quality	General aquatic dependent species	G-MW, DSE	December 2008	\$90,000	Broken LSRR	Medium
17	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	Summer 2008-2009	\$72,600	VEFMAP	Medium

Broken and Boosey Creek (All Inflow Scenarios continued)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
18	Broken Creek Rices Weir (reach 21)	i, ii, iii, v, vi, vii	Install a camera to monitor Azolla build up and movement .	Inform management decisions	Murray Cod	G-MW, DSE	Spring 2008	\$10,000	7GL	High

5.2 Actions for Unregulated Streams

Unregulated Streams (2006/2007 Inflow Scenario)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
19	Seven Creeks (reach 19)	i, ii, iii, v, vii	Continue urban winter extraction directly from the creek into Abbingers Reservoir in reach 17 to minimise impacts on Trout Cod habitat (reach 19).	Maintain aquatic habitat and water quality	Macquarie Perch, Trout Cod	GVW	July 2008	NA	NA	High
20	Seven Creeks	i, ii, iii, v, vii	Survey the Trout Cod population to determine its abundance and distribution. Assess the condition of its habitat (ARI implementing).	Inform management decisions	Trout Cod	DSE, GB CMA	Spring and autumn 2008-2009	\$25,000	RCIP	High
21	King Parrot Creek	i, ii, iii, v, vii	Survey the Macquarie Perch population to determine its abundance and distribution. Assess the condition of its habitat (ARI implementing).	Inform management decisions	Macquarie Perch	DSE, GB CMA	Spring and autumn 2008-2009	\$10,000	RCIP	High
22	Hughes Creek	i, ii, iii, v, vii	Survey the Macquarie Perch population to determine its abundance and distribution. Assess the condition of its habitat (ARI implementing). 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 and autumn 2008-2009	\$12,000	RCIP	High
23	Ryans Creek and King Parrot Creek	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	July 2008	NA	NA	High
24	Broken River (regulated), Goulburn River, Holland Creek, Howqua River, Jamieson River and Ryans Creek	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, GVW, Melbourne Water, North East Water, DSE	2008-2009	\$15,000	Fire recovery	Medium

Unregulated Streams (2006/2007 Inflow Scenario continued)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
25	Holland Creek, Hughes Creek and King Parrot Creek	i, ii, iii, v, vii	Enforce existing irrigation restriction and suspension rules.	Maintain aquatic habitat and water quality	Macquarie Perch, Murray Cod,	G-MW	July 2008	NA	NA	High
26	Holland Creek, Hughes Creek and King Parrot Creek	i, ii, iii, v, vii	Continue to enforce irrigation suspensions until flow conditions improve.	Maintain aquatic habitat and water quality	Macquarie Perch, Murray Cod,	G-MW	July 2008	NA	NA	High
27	Holland Creek, Hughes Creek, King Parrot Creek, Leary's Creek Seven Creeks 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	July 2008	\$10,000	RCIP	High
28	Selected streams and reaches	i, ii, iii, iv, v, vii	Continue to monitor the impact of drought on water quality, in-stream health and riparian health at a number of streams (includes purchase of a water quality monitoring kit).	Inform management decisions	Macquarie Perch, Murray Cod, Barred Galaxias, Trout Cod, general ecological values and functions	G-MW, DSE	Ongoing	\$40,000	RCIP/ EWR/ RHWQ	High
29	Leary's Creek	i, ii, iii	Monitor the Barred Galaxias population and its habitat (DSE implementing).	Avoid local extinction of population	Barred Galaxias	GB CMA, ARI	Ongoing	Unknown	DSE/ARI	High
30	Sunday Creek	i, ii, iii	Assess whether Sunday Creek has suitable habitat to support the return of the Barred Galaxias population. If there is not suitable habitat continue to house the population in tanks at ARI (ARI implementing).	Avoid local extinction of population	Barred Galaxias	DSE, GB CMA	Spring and summer 2008	Unknown	DSE/ARI	High
31	Streams in the Mt. Buller, Woods Point, Marysville, Mt. Disappointment and Toolangi areas (including Leary's and Sunday Creeks) that support Barred Galaxias populations	i, ii, iii	Monitor Barred Galaxias populations and the condition of their habitat. Monitor and control predator species (alien trout). Maintain predator barriers (ARI implementing).	Avoid local extinction of population	Barred Galaxias	DSE, GB CMA	Spring and autumn 2008-2009	\$40,000	DSE	High
32	Yea River	i, ii, iii, v, vii	Maintain existing urban passing flows.	Maintain aquatic habitat and water quality	Macquarie Perch	GVW, Melbourne Water	July 2008	NA	NA	Medium
33	Yea River	i, ii, iii, v, vii	Enforce existing irrigation restriction and suspension rules.	Maintain aquatic habitat and water quality	Macquarie Perch	G-MW	July 2008	NA	NA	Medium

Unregulated Streams (2006/2007 Inflow Scenario continued)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
34	Yea River	i, ii, iii, v, vii	Continue to enforce irrigation suspensions until flow conditions improve.	Maintain aquatic habitat and water quality	Macquarie Perch	G-MW	July 2008	NA	NA	Medium
35	Acheron River, Delatite River, Ryans Creek and Seven Creeks	i, ii, iii, iv, v, vii	Enforce existing irrigation restriction and suspension rules.	Maintain aquatic habitat and water quality	Brown Toadlet, Murray Spiny Cray, Murray Cod, Stonefly, Ecologically Healthy River, Growling Grass Frog	G-MW	July 2008	NA	NA	Medium
36	Delatite River	i, ii, iii, v, vii	Maintain existing urban passing flows over summer. If extra water is required it is to be extracted prior to the end of December.	Maintain aquatic habitat and water quality	Murray Cod, Stonefly	GVW	July 2008	NA	NA	Low
37	Acheron River, Delatite River, Ryans Creek and Seven Creeks	i, ii, iii, iv, v, vii	Continue to enforce irrigation suspensions until flow conditions improve.	Maintain aquatic habitat and water quality	Brown Toadlet, Murray Spiny Cray, Murray Cod, Stonefly, Ecologically Healthy River, Growling Grass Frog	G-MW	July 2008	NA	NA	Medium

Unregulated Streams (99%, 95% and 90% Probability of Exceedence Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
38	Seven Creeks	i, ii, iii, v, vii	Survey the Trout Cod population to determine its abundance and distribution. Assess the condition of its habitat (ARI implementing).	Inform management decisions	Trout Cod	DSE, GB CMA	Spring and autumn 2008-2009	\$25,000	RCIP	Medium
39	King Parrot Creek	i, ii, iii, v, vii	Survey the Macquarie Perch population to determine its abundance and distribution. Assess the condition of its habitat (ARI implementing).	Inform management decisions	Macquarie Perch	DSE, GB CMA	Spring and autumn 2008-2009	\$10,000	RCIP	Medium
40	Hughes Creek	i, ii, iii, v, vii	Survey the Macquarie Perch population to determine its abundance and distribution. Assess the condition of its habitat (ARI implementing). 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 and autumn 2008-2009	\$12,000	RCIP	Medium

Unregulated Streams (99%, 95% and 90% Probability of Exceedence Inflow Scenarios continued)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
41	Broken River (regulated), Goulburn River, Holland Creek, Howqua River, Jamieson River and Ryans Creek	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, GVW, Melbourne Water, North East Water, DSE	2008-2009	\$15,000	RCIP	Medium
42	Leary's Creek	i, ii, iii	Monitor the Barred Galaxias population and its habitat (DSE implementing).	Avoid local extinction of population	Barred Galaxias	GB CMA, ARI	Ongoing	Unknown	DSE/ARI	Medium
43	Sunday Creek	i, ii, iii	Assess whether Sunday Creek has suitable habitat to support the return of the Barred Galaxias population. If there is not suitable habitat continue to house the population in tanks at ARI (ARI implementing).	Avoid local extinction of population	Barred Galaxias	DSE, GB CMA	Spring and summer 2008	Unknown	DSE/ARI	Medium
44	Streams in the Mt. Buller, Woods Point, Marysville, Mt. Disappointment and Toolangi areas (including Leary's and Sunday Creeks) that support Barred Galaxias populations	i, ii, iii	Monitor Barred Galaxias populations and the condition of their habitat. Monitor and control predator species (alien trout). Maintain predator barriers (ARI implementing).	Avoid local extinction of population	Barred Galaxias	DSE, GB CMA	Spring and autumn 2008-2009	\$40,000	DSE	Medium
45	Yea River and King Parrot Creek	i, ii, iii, v, vii	Maintain existing urban passing flows.	Maintain aquatic habitat and water quality	Macquarie Perch	GVW, Melbourne Water	July 2008	NA	NA	Medium
46	Holland Creek, Hughes Creek and King Parrot Creek	i, ii, iii, v, vii	Enforce existing irrigation restriction and suspension rules.	Maintain aquatic habitat and water quality	Macquarie Perch, Murray Cod	G-MW	July 2008	NA	NA	Medium
47	Holland Creek, Hughes Creek and King Parrot Creek	i, ii, iii, v, vii	Continue to enforce irrigation suspensions until flow conditions improve.	Maintain aquatic habitat and water quality	Macquarie Perch, Murray Cod	G-MW	July 2008	NA	NA	Medium
48	Yea River	i, ii, iii, v, vii	Enforce existing irrigation restriction and suspension rules.	Maintain aquatic habitat and water quality	Macquarie Perch	G-MW	July 2008	NA	NA	Medium

Unregulated Streams (99%, 95% and 90% Probability of Exceedence Inflow Scenarios continued)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
49	Yea River	i, ii, iii, v, vii	Continue to enforce irrigation suspensions until flow conditions improve.	Maintain aquatic habitat and water quality	Macquarie Perch	G-MW	July 2008	NA	NA	Medium
50	Holland Creek, Hughes Creek and King Parrot Creek	i, ii, iii, v, vii	Enforce existing irrigation restriction and suspension rules.	Maintain aquatic habitat and water quality	Macquarie Perch, Murray Cod	G-MW	July 2008	NA	NA	Medium
51	Ryans Creek	i, ii, iii, iv, v, vii	Maintain existing urban passing flows.	Maintain aquatic habitat and water quality	Ecologically Healthy River, Growling Grass Frog	North East Water	July 2008	NA	NA	Medium
52	Delatite River	i, ii, iii, v, vii	Maintain existing urban passing flows.	Maintain aquatic habitat and water quality	Murray Cod, Stonefly	GVW	July 2008	NA	NA	Low
53	Acheron River, Delatite River and Ryans Creek	i, ii, iii, iv, v, vii	Enforce existing irrigation restriction and suspension rules.	Maintain aquatic habitat and water quality	Brown Toadlet, Murray Spiny Cray, Murray Cod, Stonefly, Ecologically Healthy River, Growling Grass Frog	G-MW	July 2008	NA	NA	Low
54	Acheron River, Delatite River and Ryans Creek	i, ii, iii, iv, v, vii	Continue to enforce irrigation suspensions until flow conditions improve.	Maintain aquatic habitat and water quality	Brown Toadlet, Murray Spiny Cray, Murray Cod, Stonefly, Ecologically Healthy River, Growling Grass Frog	G-MW	July 2008	NA	NA	Low

5.3 Actions for Wetlands

Wetlands (All Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
55	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	Moirra Grass, Growling Grass Frog	GB CMA	Ongoing	NA	NA	High
56	Barmah Forest (Gulf Creek)	i, ii, v, vii	Deliver periodic pulses of water (50-100 ML/d) down Gulf Creek from the Murray River. Up to 500 ML will be required. No water will be returned to the Murray River.	Maintain aquatic habitat and water quality	Southern Pygmy Perch, Dwarf Flat-headed Gudgeon, turtles	DSE, PV	Spring and summer 2008-2009	NA	NA	High
57	Barmah Forest (Smiths Creek)	i, ii, v, vii	Deliver up to 500 ML of water to Smiths Creek via the Murray River. No water will be returned to the Murray River.	Maintain aquatic habitat and water quality	Turtles	DSE, PV	Spring and summer 2008-2009	NA	NA	Medium
58	Barmah Forest (Boals Creek)	i, ii, v, vii	Deliver up to 50 ML of water to Boals Creek from the Murray River. No water will be returned to the Murray River.	Maintain aquatic habitat and water quality	Turtles	DSE, PV	Spring and summer 2008-2009	NA	NA	Medium
59	Barmah Forest (Boals Deadwood)	v, vii	Flood Boals Deadwoods to maintain Giant Rush habitat (used by colonial-nesting waterbirds during major flood events). Up to 500-800 ML will be required. Little water will be returned to the Murray River.	Maintain aquatic habitat	Colonial-nesting waterbird habitat	DSE, PV	Spring and summer 2008-2009	NA	NA	Medium
60	Barmah Forest (Top Island Wetland)	V, vii	Flood Top Island wetland to maintain Giant Rush habitat used by colonial-nesting waterbirds during major flood events. Up to 500-800 ML will be required. No water will be returned to the Murray River.	Maintain aquatic habitat	Colonial-nesting waterbird habitat	DSE, PV	Spring and summer 2008-2009	NA	NA	Medium
61	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	Spring and summer 2008-2009	\$5,000	RCIP	High
62	Black Swamp	i, ii, v, viii	Deliver up to an additional 75 ML to Black Swamp to maintain aquatic habitat and support bird breeding events.	Maintain aquatic habitat	Waterbird habitat, River Swamp Wallaby-grass, drought refuge	DSE, PV, G-MW	Spring and summer 2008-2009	NA	NA	High

Wetlands (All Inflow Scenarios continued)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
63	Reedy Swamp	i, ii, v, viii	Deliver up to an additional 300 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 and summer 2008-2009	NA	NA	High
64	Moodies Swamp, Reedy Swamp, Kinnairds Swamp and Black Swamp	i, ii, v, viii	Monitor the ecological response of the wetlands to the application of environmental water.	Inform management decisions	Frogs, aquatic vegetation, waterbirds, water quality	DSE, PV	May to December 2008	\$42,000	RCIP	High
65	Lake Mokoan	iii	Translocate fish from Lake Mokoan to more secure aquatic habitat such as the Goulburn River and Hume Dam (DSE, G-MW and DPI Fisheries implementing)	Avoid fish deaths	Murray Cod, Golden Perch	GB CMA	November 2008	TBD	NA	High

5.4 Complimentary Actions

All Inflow Scenarios

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
66	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	Spring - autumn 2008-2009	\$200,000	RCIP/Fire Recovery	High
67	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
68	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	Spring - autumn 2008-2009	\$100,000	RCIP/Fire Recovery	High
69	Broken Creek (reach 23), Big River (reach 67), Goulburn River (reaches 11, 14, 16), King Parrot Creek (reach 51), Seven Creeks (reach 18)	i, v, vii	Assess the condition of streams using the index of Stream Condition (ISC). Indices measured included water quality, riparian vegetation, macroinvertebrates, physical form and hydrology (ISC sentinel site monitoring program).	Inform management decisions	General stream ecological values and functions	DSE	March - May 2008	\$35,000	RCIP	Medium

All Inflow Scenarios continued

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
70	Broken River (reach 6), Delatite River (reaches 71 and 72), Goulburn River (reach 16), Holland Creek (reach 15), Howqua River (reach 60), Jamieson River, King Parrot Creek (reaches 51 and 52), Ryans Creek (reach 17)	i, v, vii	Assess the condition of streams using the index of Stream Condition (ISC). Indices measured included water quality, riparian vegetation, macroinvertebrates, physical form and hydrology. In addition assess the condition of riparian habitat using a variety of methods. Assessment sites include streams recently affected by bushfires in the summer of 2006/2007 (Riparian Trend Project).	Inform management decisions	General stream ecological values and functions	DSE	March - May 2008	\$35,000	RCIP	Medium
71	Boosey Creek (reaches 32, 33 and 34), Broken Creek (reaches 25, 26, 27)	v, vii	Assess and quantify the environmental condition of instream biota (fish, macro-crustaceans, macrophytes) and physical attributes (channel form, sediment loads, water quality) (Melbourne University implementing).	Inform management decisions	General stream ecological values and functions	DSE	Ongoing	\$80,000	G-MW/GB CMA	Medium
72	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
73	Boosey Creek (reach 32)	i	Monitor the condition and abundance of the Amulla population.	Inform management decisions	Amulla	PV	Spring and summer 2008-2009	NA	NA	Low
74	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

5.5 Priority Actions

Of the 65 actions identified 26 are of high priority (listed in the Tables below) and cost a total of \$1,090,000. These actions primarily aim to avoid the local extinction of priority species including Macquarie Perch, Silver Perch, Trout Cod and Murray Cod in the Goulburn River, Broken Creek, a number of unregulated streams and Barmah Forest. The actions also aim to maintain the geographic distribution of priority species to facilitate their recovery following the return of more normal inflows.

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	Use the Goulburn Water Quality allowance to run 250 ML/day during winter 2008 for water quality and environmental flow management.	Maintain aquatic habitat and water quality	Murray Cod, Silver Perch	GB CMA Board, G-MW, DSE	June 2008	NA	NA	High

Broken River (All Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
10	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
11	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 and autumn 2008	\$15,000	RCIP	High
12	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 and autumn 2008	\$90,200	VEFMAP	High

Broken and Boosey Creeks (All Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
13	Broken Creek Nathalia to the Murray River (reaches 21-23)	i, ii, iii, v, vi, vii	Run 80-100ML/day of Goulburn River Water and flushes down the creek to: <ul style="list-style-type: none"> ● maintain water quality; ● maintain fish habitat; ● and to operate the fish ladders. Requires use of the Goulburn River Water Quality allocation to offset any loses (approximately 10GL).	Maintain aquatic habitat and water quality	Murray Cod	G-MW, DSE	Spring and summer 2008-2009	NA	NA	High

Broken and Boosey Creek (All Inflow Scenarios continued)

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, vii	Monitor fish movement upstream and downstream of weir pools (via PIT Tag readers) in response to flow regimes (ARI implementing).	Inform management decisions	Murray Cod	G-MW, DSE	Ongoing	\$15,000	10GL	High
15	Broken Creek Rices Weir (reach 21)	i, ii, iii, v, vi, vii	Monitor water quality in Rices Weir pool (includes the installation of multilevel water quality probes and a weather station).	Inform management decisions	Murray Cod	G-MW, DSE	Spring and summer 2008-2009	\$50,000	7GL	High
18	Broken Creek Rices Weir (reach 21)	i, ii, iii, v, vi, vii	Install a camera to monitor Azolla build up and movement .	Inform management decisions	Murray Cod	G-MW, DSE	Spring 2008	\$10,000	7GL	High

Unregulated Streams (2006/2007 Inflow Scenario)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
19	Seven Creeks (reach 19)	i, ii, iii, v, vii	Continue urban winter extraction directly from the creek into Abinger Reservoir in reach 17 to minimise impacts on Trout Cod habitat (reach 19).	Maintain aquatic habitat and water quality	Macquarie Perch, Trout Cod	GVW	July 2008	NA	NA	High
20	Seven Creeks	i, ii, iii, v, vii	Survey the Trout Cod population to determine its abundance and distribution. Assess the condition of its habitat (ARI implementing).	Inform management decisions	Trout Cod	DSE, GB CMA	Spring and autumn 2008-2009	\$25,000	RCIP	High
21	King Parrot Creek	i, ii, iii, v, vii	Survey the Macquarie Perch population to determine its abundance and distribution. Assess the condition of its habitat (ARI implementing).	Inform management decisions	Macquarie Perch	DSE, GB CMA	Spring and autumn 2008-2009	\$10,000	RCIP	High
22	Hughes Creek	i, ii, iii, v, vii	Survey the Macquarie Perch population to determine its abundance and distribution. Assess the condition of its habitat (ARI implementing). 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 and autumn 2008-2009	\$12,000	RCIP	High
23	Ryans Creek and King Parrot Creek	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	July 2008	NA	NA	High

Unregulated Streams (2006/2007 Inflow Scenario continued)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
25	Holland Creek, Hughes Creek and King Parrot Creek	i, ii, iii, v, vii	Enforce existing irrigation restriction and suspension rules.	Maintain aquatic habitat and water quality	Macquarie Perch, Murray Cod,	G-MW	July 2008	NA	NA	High
26	Holland Creek, Hughes Creek and King Parrot Creek	i, ii, iii, v, vii	Continue to enforce irrigation suspensions until flow conditions improve.	Maintain aquatic habitat and water quality	Macquarie Perch, Murray Cod,	G-MW	July 2008	NA	NA	High
27	Holland Creek, Hughes Creek, King Parrot Creek, Leary's Creek Seven Creeks 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	July 2008	\$10,000	RCIP	High
28	Selected streams and reaches	i, ii, iii, iv, v, vii	Continue to monitor the impact of drought on water quality, in-stream health and riparian health at a number of streams (includes purchase of a water quality monitoring kit).	Inform management decisions	Macquarie Perch, Murray Cod, Barred Galaxias, Trout Cod, general ecological values and functions	G-MW, DSE	Ongoing	\$40,000	RCIP/ EWR/ RHWQ	High
29	Leary's Creek	i, ii, iii	Monitor the Barred Galaxias population and its habitat (DSE implementing).	Avoid local extinction of population	Barred Galaxias	GB CMA, ARI	Ongoing	Unknown	DSE/ARI	High
30	Sunday Creek	i, ii, iii	Assess whether Sunday Creek has suitable habitat to support the return of the Barred Galaxias population. If there is not suitable habitat continue to house the population in tanks at ARI (ARI implementing).	Avoid local extinction of population	Barred Galaxias	DSE, GB CMA	Spring and summer 2008	Unknown	DSE/ARI	High
31	Streams in the Mt. Buller, Woods Point, Marysville, Mt. Disappointment and Toolangi areas (including Leary's and Sunday Creeks) that support Barred Galaxias populations	i, ii, iii	Monitor Barred Galaxias populations and the condition of their habitat. Monitor and control predator species (alien trout). Maintain predator barriers (ARI implementing).	Avoid local extinction of population	Barred Galaxias	DSE, GB CMA	Spring and autumn 2008-2009	\$40,000	DSE	High

Wetlands (All Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
55	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	Moirra Grass, Growling Grass Frog	GB CMA	Ongoing	NA	NA	High
56	Barmah Forest (Gulf Creek)	i, ii, v, vii	Deliver periodic pulses of water (50-100 ML/d) down Gulf Creek from the Murray River. Up to 500 ML will be required. No water will be returned to the Murray River.	Maintain aquatic habitat and water quality	Southern Pygmy Perch, Dwarf Flat-headed Gudgeon, turtles	DSE, PV	Spring and summer 2008-2009	NA	NA	High
61	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	Spring 2008	\$5,000	RCIP	High
62	Black Swamp	i, ii, v, viii	Deliver up to an additional 75 ML to Black Swamp to maintain aquatic habitat and support bird breeding events.	Maintain aquatic habitat	Waterbird habitat, River Swamp Wallaby-grass, drought refuge	DSE, PV, G-MW	Spring and summer 2008-2009	NA	NA	High
63	Reedy Swamp	i, ii, v, viii	Deliver up to an additional 300 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 and summer 2008-2009	NA	NA	High
64	Moodies Swamp, Reedy Swamp, Kinnairds Swamp and Black Swamp	i, ii, v, viii	Monitor the ecological response of the wetlands to the application of environmental water.	Inform management decisions	Frogs, aquatic vegetation, waterbirds, water quality	DSE, PV	May to December 2008	\$42,000	RCIP	High
65	Lake Mokoan	iii	Translocate fish from Lake Mokoan to more secure aquatic habitat such as the Goulburn River and Hume Dam (DSE, G-MW and DPI Fisheries implementing)	Avoid fish deaths	Murray Cod, Golden Perch	GB CMA	November 2008	TBD	NA	High

Complimentary Actions (All Inflow Scenarios)

No.	Location	Mgt Objective	Action	Purpose	Ecological Values Targeted	Consultation	Timing	Cost	Funding	Priority
66	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	Spring - autumn 2008-2009	\$200,000	RCIP/Fire Recovery	High
67	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
68	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	Spring - autumn 2008-2009	\$100,000	RCIP/Fire Recovery	High

6 Links

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:

1. Receive notification of fish kills from agencies or the public.
1. Notify other relevant agencies and stakeholders so that they may respond.
2. As necessary, direct other agencies to clean up (remove dead fish from waterways) in order to protect the environment.
3. Investigate fish kill incidents and determine, if possible, the cause of the fish kill.
4. As appropriate, undertake enforcement action and recover costs consistent with EPA's Enforcement Policy.
5. Coordinate media releases.
6. 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).

North East Fire Recovery Management

The Department of Human Services is responsible for the overall coordination of the recovery process. To facilitate the regional recovery process however, the Regional Recovery Committee was activated on 13 December 2006 with the following objectives:

- To co-ordinate State Government and associated agencies' activities in support of recovery for the North East Bushfire emergency.
- To provide advice and support on bushfire recovery issues to local governments within Hume Region.
- To advise government, through the State Emergency Recovery Committee of issues requiring State level intervention or policy clarification.

Committee representation includes Local Government, Department of Sustainability (DSE), Department of Primary Industries (DPI), Environmental Protection Agency (EPA), Tourism, Goulburn-Murray Water (G-MW), North East Water Authority (NEWA), Victoria State Emergency Service (SES), Country Fire Authority (CFA), Centrelink, Salvation Army, Goulburn-Broke Catchment Management Authority (GBCMA), Department of Education (DoE), Victorian Council of Churches (VCC), Regional Development Victoria (RDV), Department for Victorian Communities (DVC), Victorian Farmers Federation (VFF), Rural Finance Victoria (RFV) and DHS.

Based on the four key aspects of recovery – social, economy, infrastructure and environment, the following tasks have been identified by the Committee to assist developing the appropriate recovery strategies:

- Identify key regional issues affecting recovery.
- Develop a Strategic Planning Document articulating appropriate treatment strategies and resource requirements.

7 Communication and 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 17 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 18).

Table 17 Stakeholder engagement.

Stakeholder	Method of Engagement	Frequency
Local community	<ul style="list-style-type: none"> • Produce fact sheet on CMAs role during Dry Inflow and activities planned. • Joint media releases with G-MW when Qualification of Rights take place. • Respond to requests for information. • Media releases around good news stories – e.g. Drought Employment Program. • Continue to support the Drought Employment Program. • 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. • Provide input to Goulburn-Murray Water's Dry Inflow response newsletters. • Develop Dry Inflow page on website and update to ensure activities remain current. 	<ul style="list-style-type: none"> • Distribute via website and as required • As required • As required • As available • Ongoing • As required • As available • Update at least monthly
Goulburn-Murray Water	<ul style="list-style-type: none"> • Gain input from G-MW on GB CMA Dry Inflow response plan. • 1:1 communication. • Joint media releases when Qualification of Rights take place. • Informal discussions regarding joint Dry Inflow management. • Providing environmental advice on Water Supply Demand Strategies. 	<ul style="list-style-type: none"> • ASAP • Ongoing • As required • Ongoing • As required
Goulburn Valley Water and North East Regional Water Authorities	<ul style="list-style-type: none"> • 1:1 communication. 	<ul style="list-style-type: none"> • Ongoing
Landcare groups/ Greening Australia	<ul style="list-style-type: none"> • Use as forum to promote CMA activities throughout Dry Inflow. 	<ul style="list-style-type: none"> • Opportunistic
EPA	<ul style="list-style-type: none"> • Establish common means of dealing with communications when fish kills occur e.g. joint media releases. • Provide support to deal with communications when fish kills occur e.g. joint media releases. 	<ul style="list-style-type: none"> • Ongoing • As required

Table 17 (continued).

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

Table 18 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"> The message that key endangered or vulnerable environmental assets are being targeted. Complementary works that are being undertaken to protect environmental assets. The message that both communities and the environment are under stress. The message that 'it's keeping the vine alive, not trying to grow fruit'.
Inconsistent messages between GB CMA and Goulburn-Murray Water within any Qualifications of Rights	<ul style="list-style-type: none"> Produce joint media releases where appropriate. Provide advice as necessary to G-MW on protection of environmental assets when qualifying rights. Maintain relationships with G-MW to ensure early input during the QoR process.
Deterioration of GB CMAs reputation during the Dry Inflow	<ul style="list-style-type: none"> Continue community engagement practices eg landcare, waterwatch, Drought Employment Program. Engage community in complementary activities as appropriate. Maintain visible presence in the community throughout the Dry Inflow. Key messages around the role of GB CMA during Dry Inflow also address some of this risk.
Lack of stakeholder understanding about the role of GB CMA during the Dry Inflow	<ul style="list-style-type: none"> Produce communications material outlining GB CMA's roles and priorities during the Dry Inflow. Reinforce these key messages in all subsequent material relating to GB CMA and Dry Inflow.

8 References

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Appendix 1 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").

The table below summaries the annual environmental water entitlements available for use in the Goulburn Broken Catchment.

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 ¹	MDBC	-	-	-	√	-	√	-	-	-
Goulburn Living Murray Bulk Entitlement	141,046 ¹	MDBC	-	-	-	√	-	-	-	-	-
Broken Living Murray Environmental Entitlement	3022 ¹	MDBC	-	-	-	√	-	-	-	-	-
Goulburn Snowy Environmental Reserve Bulk Entitlement	15,352 ²	DSE	-	-	-	-	-	-	-	-	-
Broken Snowy Environmental Reserve Bulk Entitlement	990 ²	DSE	-	-	-	-	-	-	-	-	-
Barmah-Millewa Forest Entitlement	150,000 ³	DSE	-	-	-	-	-	√	-	-	-
Victorian River Murray Flora and Fauna Bulk Entitlement	27,600 ⁴	DSE	√	-	√	√	-	√	√	√	√
Stockyard Plain Bulk Entitlement	112 ⁵	DSE	√	√	√	√	-	√	√	√	√
One Tree Swamp Bulk Entitlement	9.3 ⁵	PV	√	√	√	√	-	√	√	√	√
Gaynors Swamp Bulk Entitlement	40.2 ⁶	PV	√	√	√	√	-	√	√	√	√
Goulburn Water Quality Allowance	30,000 ⁷	G-MW	√	-	√	-	-	-	-	-	-
Goulburn River Additional Passing Flows	80,000 ⁸	DSE	√	-	-	-	-	-	-	-	-
Summer Minimum Flow (see text below)	NA	G-MW	√	√	-	√	√	-	-	-	-
Winter Minimum Flow (see text below)	NA	G-MW	√	√	-	√	√	-	-	-	-
Surplus (unregulated) flows ⁹	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 MDB. 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 2 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 resultant impact of loss of flora and fauna populations.

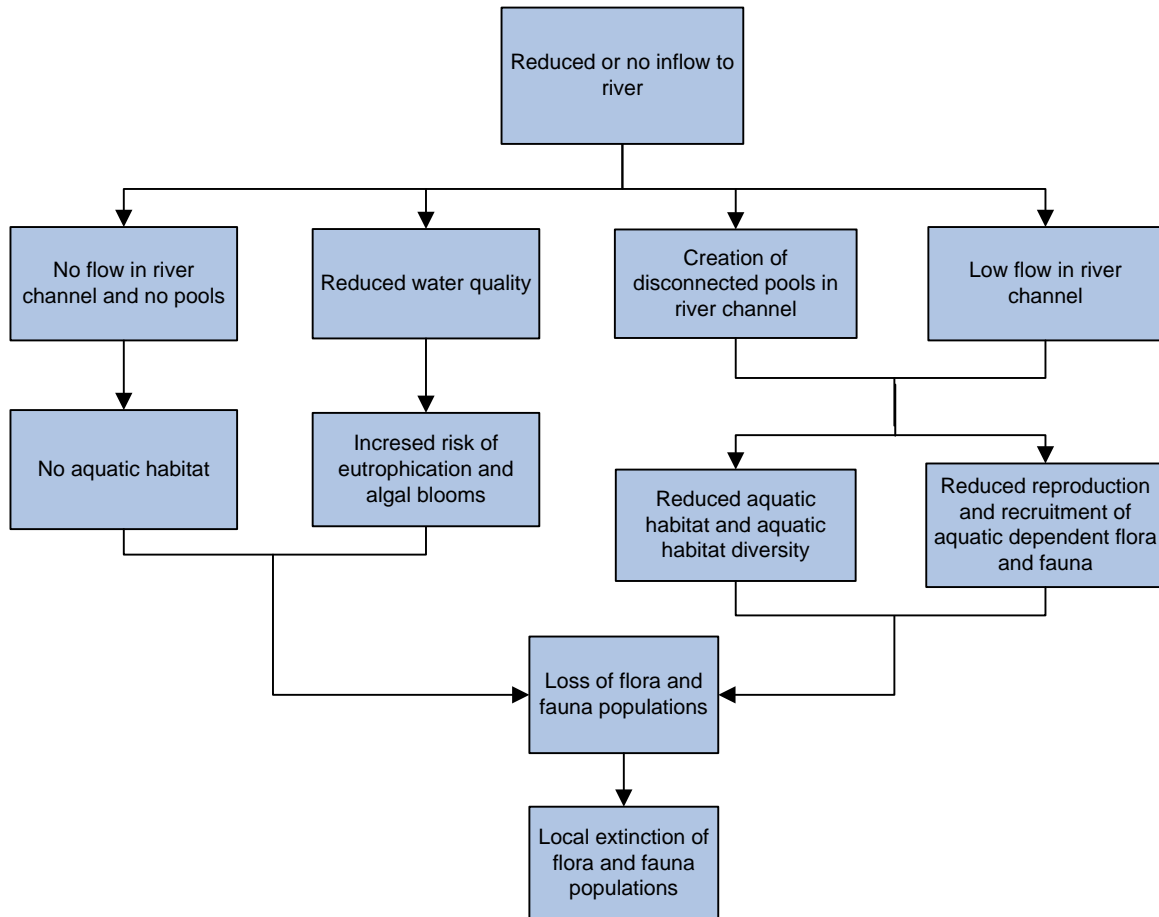


Figure 4 Regulated streams and their reach numbers.



Figure 5 Unregulated streams and their reach numbers.

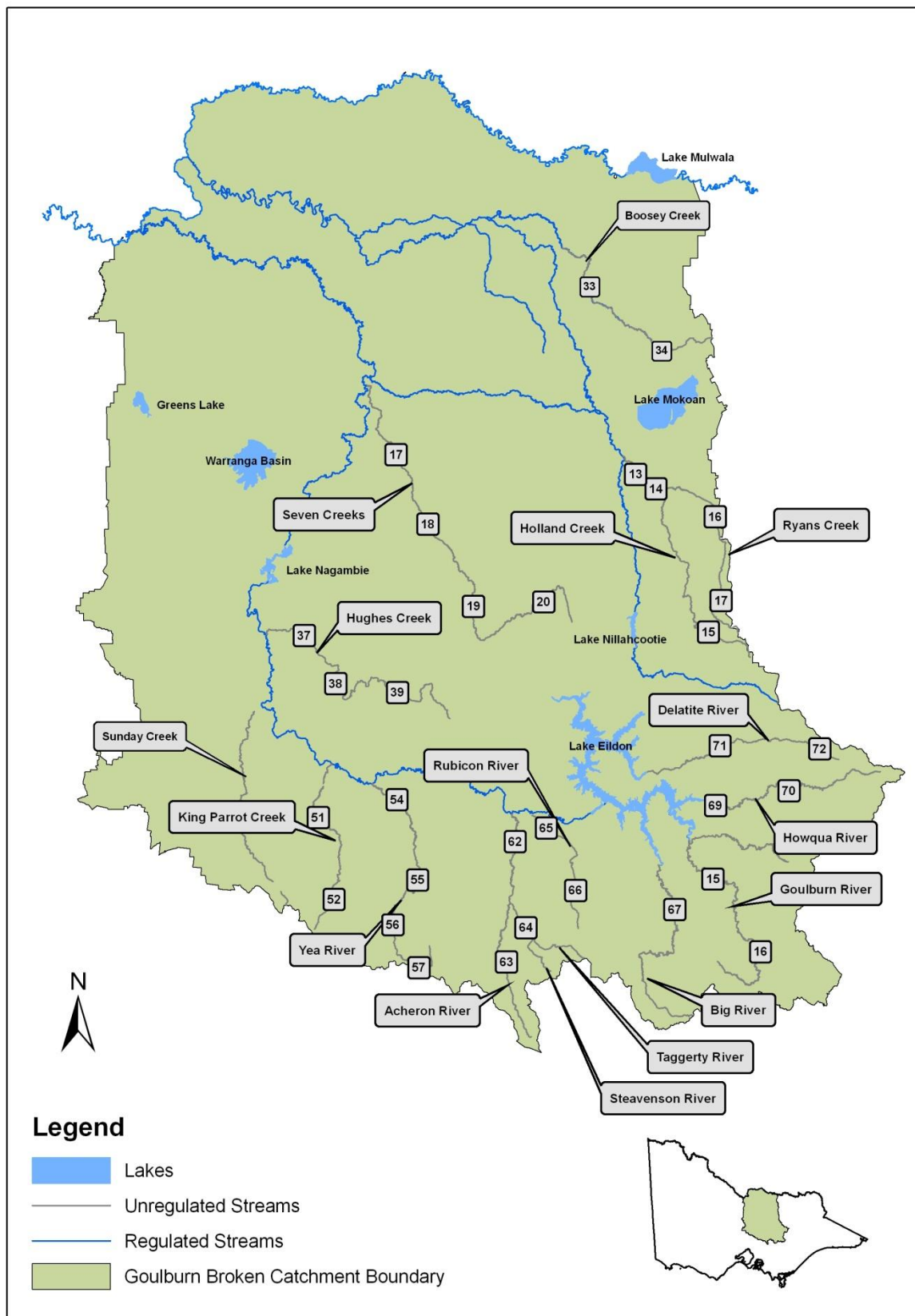


Figure 6 Priority wetlands.

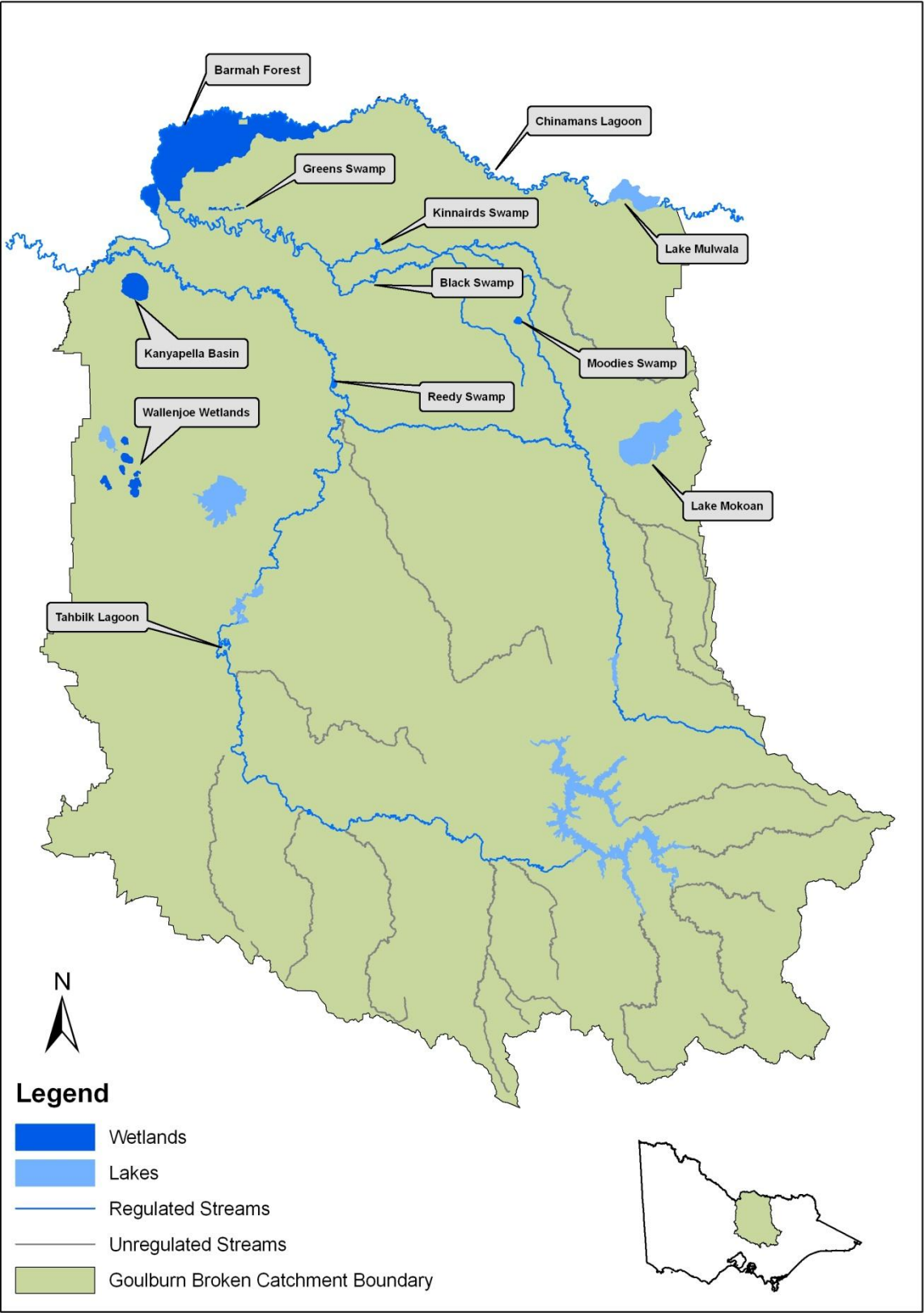


Figure 8 Area burnt in the Goulburn Broken Catchment by the 2006-2007 bush fires.

