Barmah Forest Ramsar Site
Strategic Management Plan

Victoria The Place To Be

Department of
Sustainability and Environment

Parks Victoria developed this Strategic Management Plan in conjunction with the Department of Sustainability and Environment and key stakeholders, and coordinated the public comment process on the draft document.

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This report is prepared without prejudice to any negotiated or litigated outcome of any Native Title Determination Application covering land or waters within the plan's area. It is acknowledged that any future outcomes of Native Title Determination Applications may necessitate amendment of this report; and the implementation of this plan may require further notifications under the procedures in Division 3 Part 2 of the *Native Title Act 1993* (Cwlth).

The plan is also prepared without prejudice to any future negotiated outcomes between the Government/s and Victorian Aboriginal communities. It is acknowledged that such negotiated outcomes may necessitate amendment of this plan.

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Contents

1 Introduction

The Strategic Management Plan for the Barmah Forest Ramsar site is an integral component of a program to develop a comprehensive management framework for Victoria's Wetlands of International Importance (or 'Ramsar sites') listed under the Convention on Wetlands (Ramsar, Iran, 1971). The primary goal of the management framework is to maintain the ecological character of Victoria's Ramsar sites through conservation and wise use.

1.1 Strategic Directions Statement

The Strategic Directions Statement establishes Management Objectives for Victoria's Ramsar sites and Statewide Management Strategies to achieve these objectives. The Strategic Management Plans for the individual Victorian Ramsar sites apply the Management Objectives and Statewide Management Strategies, promoting a range of specific Site Management Strategies that will maintain, and in some cases restore, the ecological character of the sites. Individual plans cover 10 of Victoria's 11 Ramsar sites. Victoria's eleventh Ramsar site, the Edithvale-Seaford Wetlands, was listed in 2001 and is covered by a separate management plan. A diagram of the framework and related documents is shown below in Figure 1.1.

The Strategic Directions Statement provides the overarching policy framework for managing Ramsar sites in Victoria. It establishes Management Objectives for Ramsar site management across the State, which are then translated to the site-specific level by each of the Strategic Management Plans. The Management Objectives outlined by the Strategic Directions Statement are as follows:

1. Increase the scientific understanding of wetland ecosystems and their management requirements.
2. Maintain or seek to restore appropriate water regimes.
3. Address adverse processes and activities.
4. Manage Ramsar sites within an integrated catchment management framework.
5. Manage resource utilisation on a sustainable basis.
6. Protect, and where appropriate enhance, ecosystem processes, habitats and species.
7. Encourage strong partnerships between management agencies.
8. Promote community awareness and understanding and provide opportunities for involvement in management.
9. Ensure recreational use is consistent with the protection of natural and cultural values.
10. Develop ongoing consistent programs to monitor ecological character.

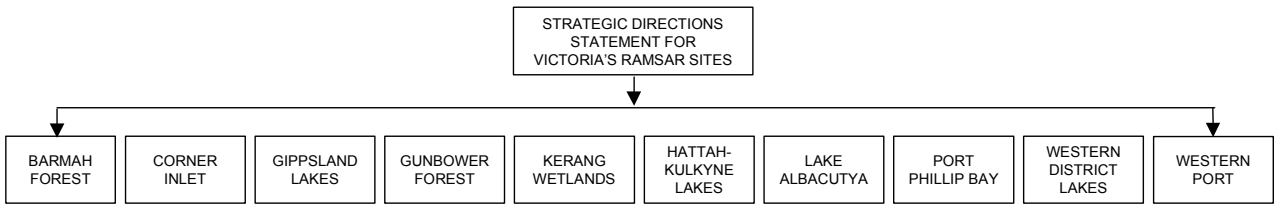
The Strategic Directions Statement also provides background information on the suite of relevant international conventions, as well as related Commonwealth and State policy and legislation, which directs and supports the management of Ramsar sites. The Strategic Directions Statement and Strategic Management Plans are therefore intended to be read as complementary documents.

1.2 Purpose of the Strategic Management Plan

The primary purpose of the Strategic Management Plan (SMP) for the Barmah Forest Ramsar site is to facilitate conservation and wise use of the site so as to maintain, and where practical restore, the ecological values for which it is recognised as a Ramsar wetland. This will be achieved by implementing site-specific management strategies under each of the key objectives (derived from the Strategic Directions Statement).

The SMP for the Barmah Forest Ramsar site provides management agencies and stakeholders with an appropriate management framework and the necessary information to ensure that decisions regarding land use and development, and ongoing management are made with full regard for wetland values in environmental, social and economic terms.

Figure 1.1 Framework for the strategic management of Victoria's Ramsar sites



The SMP has been structured in order to:

- provide a comprehensive site description;
- examine the legislation, policy and any related management instruments which direct or otherwise influence management both within and adjacent to the site;
- clarify the roles and responsibilities of management agencies;
- identify the values for which the site is recognised as a Ramsar site;
- assess threats to these values through systematic analysis of both current and potential risks; and
- give priority to Site Management Strategies that minimise and, where possible, eliminate identified risks to values.

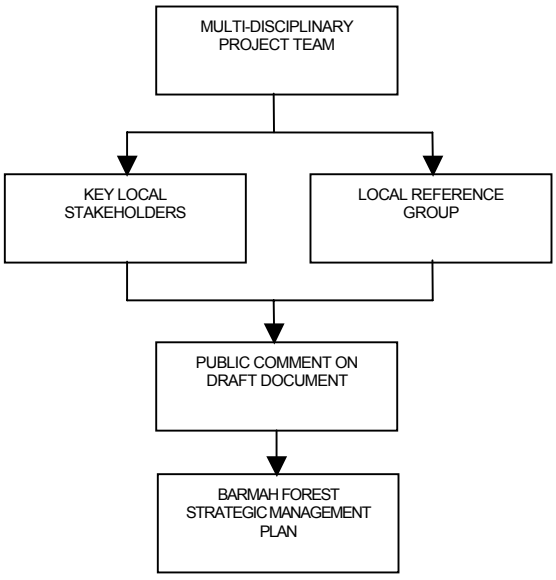
1.3 Consultative framework

The SMP has been developed collaboratively through a multi-disciplinary team comprised of the staff from regional and central offices of Parks Victoria and the Departments of Sustainability and Environment and Primary Industries. Throughout the process members of a Local Reference Group and key local stakeholders have provided input (see Figure 1.2).

The SMP is a public document that has been formalised through a government approval process. As such, the SMP was subject to a public comment phase commensurate with State Government consultative processes. All comments received during the public consultation phase were considered in finalising the document.

The SMP is intended to operate over a six-year time frame and will be reviewed every three years to coincide with national reporting requirements under the Convention on Wetlands.

Figure 1.2 Process for developing the SMP for the Barmah Forest Ramsar site.



2 Ramsar Site Description

2.1 Location

The Barmah Forest Ramsar site is located on the Murray River floodplain approximately 225 km north of Melbourne. It is in the Victorian Riverina bioregion (Murray Fans subregion). The Barmah Forest Ramsar site covers 28,515 ha and is predominantly River Red Gum open forest and woodland.

2.2 Wetland type

Within the Barmah Forest Ramsar site four inland wetland types are recognised under the classification system used by the Ramsar Convention:

- seasonal, intermittent or irregular rivers, streams and creeks;
- permanent freshwater lakes over 8 ha (including floodplains);
- seasonal or intermittent freshwater marshes or pools on inorganic soils (including sloughs, potholes, seasonally flooded meadows and sedge marshes); and
- freshwater, tree dominated wetlands (includes freshwater swamp forest, seasonally flooded forest and wooded swamps on inorganic soils).

In Victoria wetlands are classified into eight categories (Corrick and Norman 1980). The Barmah Forest Ramsar site includes areas of four wetland types under this system:

- deep freshwater marsh (884 ha);
- freshwater meadow (18,323 ha);
- permanent open freshwater (289 ha); and
- shallow freshwater marsh (7,332 ha).

Barmah is of special value for maintaining the genetic and ecological diversity of the region because of its size, variety of communities and its high productivity. Barmah Forest also has the most extensive areas of Moira grasslands in Victoria (CFL 1990).

The majority of Barmah Forest functions as a single floodplain wetland system that is dependent on regular river flooding. Component wetlands vary considerably in their seasonality, characteristics and size. Wetlands range from permanent lakes, billabongs and ponding effluents; through shallow basins with prolonged seasonal flooding which support rushland or grassland (Moira Grass) communities; to a gradational series of River Red Gum forest or woodland communities with wetland understorey's determined largely by flooding frequency and duration. Box woodland communities occur above the normal high flood level.

2.3 Criteria met for Ramsar listing

To be listed as a Wetland of International Importance, or 'Ramsar site', wetlands must meet one or more internationally accepted criteria in relation to their zoology, botany, ecology, hydrology or limnology and importance to waterbirds. The Ramsar Convention updated the criteria in 1999. The new criteria will be applied to Barmah Forest when the site Ramsar Information Sheet is next updated in 2005. The former criteria met by the Barmah Forest site when listed in 1982 were:

1(a) a particularly good representative of a natural or near-natural wetland characteristic of one, or common to more than one, biogeographical region;

2(b) is of special value for maintaining the genetic and ecological diversity of the flora and fauna of the region;

3(a) regularly supports >20,000 waterbirds;

3(b) regularly supports substantial numbers of individuals from particular groups of waterbirds; and

3(c) regularly supports 1% of the individuals of a population of one species or subspecies of waterbirds.

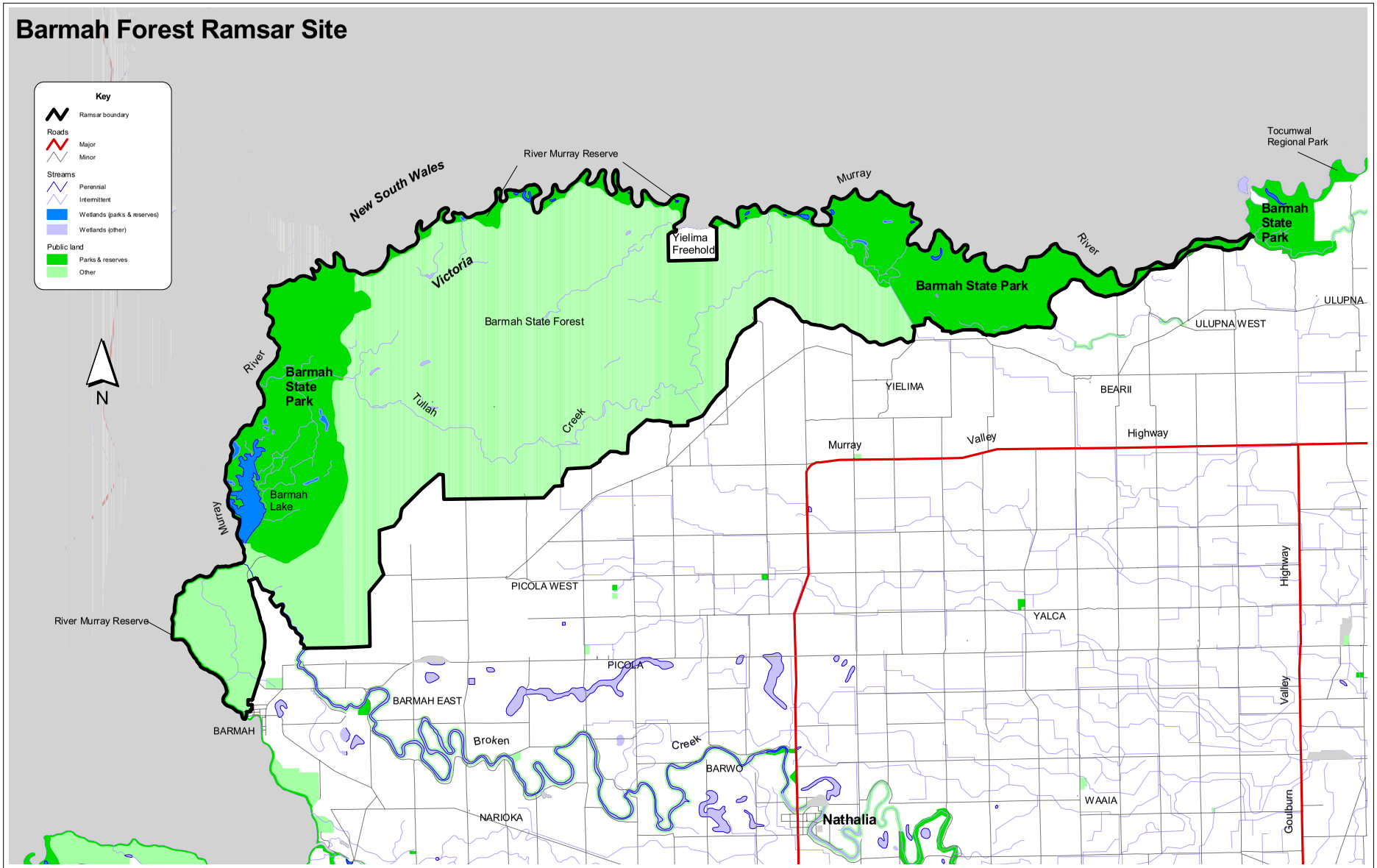
Information on how the Barmah Forest Ramsar site meets these criteria is detailed in Chapter 4.

2.4 Land tenure and management

Parks Victoria and the Department of Sustainability and Environment manage the Barmah Forest Ramsar site under the provisions of relevant legislation (Table 2.1).

Barmah State Park covers an area of 7,900 ha proclaimed under the *National Parks Act 1975* and is managed by Parks Victoria. The Barmah Forest Ramsar site does not include the Ulupna Island section of the State Park. The State Park is required to be managed in accordance with the Act and the following Government approved recommendations of the former Land Conservation Council (LCC):

Barmah Forest Ramsar Site



- provide opportunities for recreation and education associated with the enjoyment and understanding of natural environments;
- conserve and protect natural ecosystems; and
- be used as part of the river regulation and flood mitigation system of the Murray River (LCC 1985).

The Barmah Forest Ramsar site contains two reference areas, Top Island (177 ha) and Top End (124 ha). These areas are proclaimed under the *Reference Areas Act 1978* and are managed by Parks Victoria. Reference areas are required to be managed in accordance with the following Government approved recommendations of the LCC:

- be used to maintain natural ecosystems as a reference to which those concerned with studying land for particular comparative purposes may be permitted to refer, especially when attempting to solve problems arising from the use of land;
- be surrounded by a buffer, and that delineation of the buffer be by joint arrangement between the advisory committee and the land manager of both the area itself and the land adjacent to the area; and
- activities (such as grazing, exploration for minerals and gold, logging, and beekeeping) that conflict with the purposes of a reference area not be permitted (LCC 1985).

Barmah State Forest, area of 21,320 ha reserved under the *Forests Act 1958,* is managed by the Department of Sustainability and Environment. State Forests are required to be managed in accordance with the following Government approved recommendations of the LCC:

- produce hardwood timber;
- conserve native plants and animals, and provide opportunities for the development of wildlife conservation techniques;
- provide opportunities for open-space recreation (including hunting) and education;
- provide for flood mitigation; and
- produce honey, forage, gravel, sand, and other forest produce such as charcoal (LCC 1985).

The Murray River Reserve follows the Murray River as well as the major anabranches. It consists of a 60-metre wide public purposes reserve and is reserved under the *Crown Land (Reserves) Act 1978* and managed by Parks Victoria. This section of the river was formally recommended as the Barmah Regional Park by the LCC in 1985 but the recommendation was not accepted by Government. The Murray River Reserve is required to be managed in accordance with the following management recommendations of the LCC:

- provide opportunities for informal recreation (including camping) in a riverine environment for large numbers of people;
- conserve and protect ecosystems to the extent that is consistent with the above;
- apiculture be permitted;
- use of existing and licensed pump and pump-line sites be permitted to continue;
- hunting of game birds be permitted during the declared hunting period in areas specified by the land manager where conflict with other recreational users such as camping does not occur; and
- stock access to water and grazing be permitted at the discretion of the land manger where this is compatible with zone management goals (LCC 1985).

The Dharnya Centre is managed by the Yorta Yorta Nations with Parks Victoria Indigenous staff seconded to the Centre. A Committee of Management comprising members form the Yorta Yorta and Parks Victoria oversee the running of the Centre. The Committee of Management was established in 1991 under Section 50(3)(a) of the *Forests Act 1958* and determines the future management of the Centre by making decisions, establishing actions and implementing programs.

Barmah Forest and the adjacent Millewa Forest in New South Wales form an ecological unit. The Murray-Darling Basin Commission (MDBC), the Department of Sustainability and Environment (DSE), Goulburn-Murray Water, State Forests of NSW and the NSW Department of Infrastructure, Planning and Natural Resources work together with other stakeholders to improve water management of the Barmah-Millewa Forest, especially in relation to the use of environmental water allocations. The Barmah-Millewa Forum comprises representatives from each of the key stakeholders (Appendix 6) and recommends options for management and research within these forests.

A range of management agencies are responsible for ensuring that management of the site complies with a broad range of legislative requirements. The successful management of the Barmah Forest Ramsar site relies on effective cooperation and partnership between

the various management agencies, in collaboration with local stakeholders.

Lead management agencies and their key responsibilities are summarised in Table 2.2.

2.5 Adjacent land use

Across the Murray River in New South Wales is the Millewa group of State Forests. Private land fronts the Murray River in New South Wales at Picnic Point and for about 4 km downstream of Ulupna Island.

Most of the land adjacent to the southern boundary of the forest is privately owned and has been cleared for agriculture.

A block of freehold land known as the Yielima Pre-emptive Right covering an area of 260 ha is located on the Murray River. The Yielima Pre-emptive Right is surrounded by Barmah State Forest and adjoins Murray River Reserve. The land has been used for growing crops and grazing cattle, and is predominantly cleared. The area is now owned by the Yorta Yorta Clans Group and is being revegetated to restore some of its natural values.

Morgans Beach, a recreation reserve on public land flanked by State Park, is managed under the *Crown Land (Reserves) Act 1978*.

2.6 Catchment setting

The Barmah Forest Ramsar site is located on the floodplain of the Murray River in the Goulburn Broken Catchment Management Area. The Goulburn Broken Catchment Management Area covers 17% of Victoria, and covers an area of 24,067 km^2 supporting a population of approximately 200,000. The primary industries supported by the catchment include dryland and irrigated agriculture, food processing, forestry and tourism (GBCLPB 1997).

2.7 Local Government

The Barmah Forest Ramsar site is located in the Shire of Moira local government area. The Shire encompasses an area of over 4,078 km^2 and includes the major town centres of Cobram, Numurkah, Yarrawonga and Nathalia.

Table 2.1 Land tenure and management

Land Tenure		Area (ha)	Legal status	Management
State Park[1]		7,900	*National Parks Act 1975*	Parks Victoria
Reference Areas[2]	Top Island	177	*Reference Areas Act 1978*	Parks Victoria
	Top End	124		
State Forest		21,320	*Forests Act 1958*	Department of Sustainability and Environment
Murray River Reserve		580	*Crown Land (Reserves) Act 1978*	Parks Victoria

[1] Ulupna Island (640 ha) is included in the total area for the State Park but is not part of the Ramsar site.

[2] These areas are located within the State Park and are also included in the total area for the State Park.

Table 2.2 Lead management agencies and their key responsibilities

Statewide agency	Responsibility	Local agency	Responsibility
Parks Victoria	Management of parks and reserves.	Parks Victoria – Nathalia	Manage the State Park, Reference Areas and the Murray River Reserve.
Committees of Management	Manage reserved Crown Land on behalf of the Minister. Committees are usually the local Shire or publicly elected.	Dharnya Committee of Management	Manage the Dharnya Centre.

Statewide agency	Responsibility	Local agency	Responsibility
Department of Sustainability and Environment (DSE)	Strategic direction for park and reserve management; flora and fauna management and implementation of the Ramsar Convention in Victoria; catchment and water management, forest management, coastal and port management; leasing, licensing and management of public land, strategic and statutory land use planning including the administration of the Victorian Planning Provisions.	DSE – Nathalia	Provide policy advice on the management of the Barmah Forest Ramsar site. Manage the flora and fauna environmental water allocation, hunting, and forestry at the Barmah Forest Ramsar site. Implement the Forest Management Plan for the Mid-Murray Forest Management Area.
Department of Primary Industries (DPI)	Provide strategic direction and research for the management of fisheries, agriculture, minerals and petroleum.	DPI	Manage fishing at the Barmah Forest Ramsar site in accordance with *Fisheries Act 1995*.
Victorian Catchment Management Council	Advise State Government on catchment management, and land and water resource issues and priorities. Encourage cooperation between land and water managers. Promote community awareness on catchment management issues.	Goulburn Broken CMA	Implement the Goulburn-Broken Regional Catchment Strategy. Prepare and implement Action Plans. Licence works on waterways, floodplain authority, develop and implement Murray River Action Plan.
Local Government/Shires	Regulate local development through planning schemes, on ground works and management of local roads and urban and some rural drainage.	Shire of Moira	Administer planning scheme.
Environment Protection Authority (EPA)	Take responsibility for and coordinate all activities relating to the discharge of waste into the environment and the generation, storage, treatment, transport and disposal of industrial waste and the emission of noise and for preventing or controlling pollution and noise and protecting and improving the quality of the environment.	EPA Bendigo	Licence sewage and other discharges. Monitor water quality.
Regional Water Authorities	Provide water and sewerage service to urban communities.	Goulburn Valley Water	Provide water and sewerage services to the townships neighbouring the Ramsar site. Manage water supply and sewerage treatment plants. Monitor surface and groundwater salinity.
Rural Water Authorities	Provide irrigation, drainage, water supply, and management of specific water supply catchments.	Goulburn-Murray Water	Licence all works on waterways. Regulation of agriculture extraction. Ensure correct groundwater bore construction.
Murray-Darling Basin Ministerial Council	Determine major policy issues and measures concerning effective planning and management for the equitable, efficient and sustainable use of the water, land and other environmental resources of the Murray-Darling Basin.	Murray-Darling Basin Commission	Manage the River Murray and advise the Ministerial Council on the use of water, land and other environmental resources of the Murray-Darling Basin under the Murray-Darling Basin Agreement 1992. Coordinate management of the environmental water allocation for the Barmah-Millewa Forest through the Barmah-Millewa Forum.
		Murray-Darling Basin Commission - River Murray Water	Operate and manage the River Murray system.

3 Policy Framework

The suite of relevant international conventions and the Commonwealth and Victorian legislation and policy that directs management and use of Ramsar sites are outlined in the Strategic Directions Statement (NRE 2002a). This Chapter covers the local policy framework comprising plans, strategies and municipal planning provisions as well as statewide strategies approved after publication of the Strategic Directions Statement.

3.1 Strategies

There are a range of existing plans and strategies that provide for the protection and enhancement of the natural and cultural values of the Barmah Forest Ramsar site. Victoria has a strong planning framework and as a result these plans and strategies have a high level of integrated planning and address many aspects of wise and sustainable use. These plans and strategies include:

- Draft Goulburn Broken Regional Catchment Strategy (GBCMA 2002a);
- Draft Murray River Action Plan, Yarrawonga to Echuca (GBCMA 2002b);
- Forest Management Plan for the Mid-Murray Forest Management Area (NRE 2002b);
- The Living Murray: Restoring the Health of the Murray River (MDBMC 2002);
- Goulburn Broken Weed Action Plan (GBCMA 2001);
- Goulburn Broken Native Vegetation Plan (GBCMA 2000);
- Interim Water Management Strategy for Barmah Forest, Victoria. (Ward et al. 1994)
- Barmah-Millewa Forest Water Management Strategy (MDBC 2000);
- Entitlements to the Murray – outcomes of the work to define how Victoria's River Murray is to be shared (NRE 1999);
- Goulburn Broken Catchment Management Strategy (GBCMA 1998);
- Goulburn Broken Catchment Water Quality Strategy (GBWQWG 1997);
- Barmah State Park and Barmah State Forest Management Plan (DCE 1992);
- Watering the Barmah-Millewa Red Gum Forest (MDBC 1992); and
- Municipal Strategic Statement for Moira Shire under the *Planning and Environment Act 1987*.

Catchment management authorities in Victoria are currently reviewing their regional catchment strategies. The revised regional catchment strategies, once accredited by government, will guide future investment in the catchment under some State natural resource management programs, the National Action Plan for Salinity and Water Quality and the Natural Heritage Trust. This strategic management plan will be recognised under the Goulburn Broken Regional Catchment Strategic framework.

A Water Management Plan for Barmah Forest is currently in preparation. This plan is required as the Interim Water Management Strategy (Ward et al. 1994) is now outdated and needs to take account of recent water management developments within the Barmah-Millewa Forest.

The River Murray bulk entitlements were approved by Government in 1999. These include:

- Goulburn-Murray Water's entitlement which includes provisions for water for Barmah-Millewa Forest (NSW has approved a matching environmental water allocation); and
- a Flora and Fauna entitlement, which can be used for wetlands with access to River Murray water, including Barmah Forest.

Three recently developed statewide strategies are relevant to the management of Barmah Forest Ramsar site.

The Victorian River Health Strategy (VRHS) provides a framework that enables Government and community to manage and restore rivers in the State. The VRHS aims to achieve healthy rivers, streams and floodplains, which meet the environmental, economic, recreational and cultural needs of current and future generations (NRE 2002c). The VRHS establishes regional planning processes for CMAs to prepare regional river health strategies, which will coordinate other river-related action plans and direct the development of annual works programs.

The Indigenous Partnership Strategy (NRE 2001) provides the framework for building effective relationships with Indigenous communities, who have a fundamental role in the management of Victoria's natural resources, as traditional custodians of the land and waters. This strategy sets out key initiatives to assist in the development and delivery of services to Indigenous people,

which should be applied during management planning.

Victoria's Native Vegetation Management – A Framework for Action (NRE 2002d) establishes the strategic direction for the protection, enhancement and revegetation of native vegetation across the State. The framework focuses on managing native vegetation to provide sustainable landscapes and to protect productive capacity and environmental values of land and water resources.

In addition, the Barmah Forest Ramsar site is listed in *A Directory of Important Wetlands in Australia 3rd Edition* (EA 2001).

3.2 Municipal Strategic Statements, zoning and overlays

The Moira Shire has produced a Municipal Strategic Statement that covers the Barmah Forest Ramsar site. Although this Statement addresses a number of important land management and environmental issues, it does not emphasise the environmental values of the Barmah Forest Ramsar site and its catchment or the risks to its values.

Zoning pursuant to the *Planning and Environment Act 1987* has been applied to the Barmah Forest Ramsar site, as part of a review of local planning schemes, to control land use and development. The Public Conservation and Resource Zone (PCRZ) and Public Park and Recreation Zone (PPRZ) apply to the Ramsar site.

The Public Conservation and Resource Zone (PCRZ) aims to:

- protect and conserve the natural environment and natural processes for their historic, scientific, landscape, habitat or cultural values;
- provide facilities which assist in public education and interpretation of the natural environment with minimal degradation of the natural environment or natural processes;
- provide for appropriate resource based uses.

The Public Park and Recreation Zone (PPRZ) aims to:

- recognise areas for public recreation and open space;
- protect and conserve areas of significance where appropriate;
- provide for commercial uses where appropriate.

Furthermore, as part of the local planning scheme review, a Rural Floodway Overlay (RFO) has been applied to the Barmah Forest Ramsar site. Overlays operate in addition to zone requirements and generally concern environmental, landscape, heritage, built form, and land and site management issues. The Rural Floodway Overlay applied to the Barmah Forest Ramsar site is broad, and does not provide adequate protection to rare and threatened species and wetland, riparian and instream habitats.

4 Values

The key environmental values of the Barmah Forest Ramsar site for which it was listed (representativeness, flora and fauna and waterbirds) are summarised below. Other values described include natural function, cultural heritage, scenic, economic, education and interpretation, recreation and tourism and scientific.

4.1 Wetland representativeness

In Victoria, wetlands are classified into eight categories. The Barmah Forest Ramsar site includes areas of four of these wetland types including areas of the State's most depleted wetland habitats and wetlands least represented in Victoria's protected area network (Table 4.1). Of note the Barmah Forest Ramsar site represents approximately 15% of the remaining freshwater meadow in the State, and 13% of the remaining shallow freshwater marsh in the State.

4.2 Flora and fauna

More than 553 species of indigenous flora and 273 species of indigenous fauna have been recorded at the Barmah Forest Ramsar site (Loyn et al. 2002). Of these, 35 are listed under the Victorian *Flora and Fauna Guarantee Act 1988.* These include 7 flora species and 28 fauna species (Appendices 2 and 3).

A total of 32 flora species and 49 fauna species that are considered threatened in Victoria have been recorded at the Barmah Forest Ramsar site (DSE 2003b; DSE 2002a). In addition, 5 flora species and 3 fauna species are considered to be threatened in Australia under the *Environment Protection and Biodiversity Conservation Act 1999* (Appendices 2 and 3).

The Barmah-Millewa forest, covering an area of 70,000 ha, is the largest River Red Gum forest in Australia. The River Red Gum and Black Box forests have a high priority for conservation measures in the State (Frood and Calder 1977). The Barmah Forest Ramsar site also has the most extensive areas of Moira Grass plains in Victoria, which are of state significance. Moira Grass plains constitute about 5.5% of the forest area (DCE 1992). Ecological Vegetation Classes (EVCs) are not yet available for Barmah Forest, but are expected to be finalised in 2003.

A total of three bird species listed under the Japan-Australia Migratory Birds Agreement (JAMBA) and six species listed under the China-Australia Migratory Birds Agreement (CAMBA) have been recorded at Barmah Forest of which three are common to both agreements (Appendix 4). The Barmah Forest Ramsar site has records of 23 species listed under the Bonn Convention (Appendix 4).

The Barmah Forest Ramsar site supports a significant proportion of the Victorian population of Superb Parrot, which is endangered in Victoria and nationally vulnerable and listed under the Victorian *Flora and Fauna Guarantee Act 1988*. The Barmah State Park and State Forest contain the only locations in Victoria where the Superb Parrot is known to still breed (Webster 1988). Sixteen nest trees have been recorded and these trees are distributed in three general locations, however observed movements of parrots during the breeding season, as well as observations of adult birds feeding fledglings, strongly suggest that there may be additional nests within Barmah Forest (Davidson and Chambers 1991).

Table 4.1 Representativeness of Victorian wetland types in the Barmah Forest Ramsar site

Wetland Type	Pre European area (ha) in Victoria	Area (ha) remaining in Victoria	Area (ha) in Victoria's protected area network[1]	Ramsar coverage in Victoria (ha)	Barmah Forest (ha)
Deep Freshwater Marsh	176,601	54,860	21,877	8,943	884 (1.61%)
Freshwater meadow	181,246	118,899	8,312	27,568	18,323 (15.41%)
Permanent Open Freshwater	70,658	190,694[2]	55,729	25,352	289 (0.15%)
Shallow Freshwater Marsh	127,031	54,603	9,410	8,139	7,332 (13.43%)

1 Includes areas of Ramsar sites

2 Increases from Pre-European area in Victoria to area remaining in Victoria is due to the construction of dams, weirs and other impoundments

4.3 Waterbirds

The Barmah Forest Ramsar site provides important feeding, resting and breeding habitat for waterbird species. The Murray River and permanent creeks provide habitat for a few species, and when floodwaters extend into open plains many more appear, feeding around the shores, in beds of Giant Rush and to a lesser extent in open water. When water is deep enough, some species breed in beds of Giant Rush or surrounding trees.

Rare waterbirds recorded for Barmah include Freckled Duck and Latham's Snipe (Chesterfield et al. 1984).

The Barmah Forest Ramsar site provides one of Victoria's largest waterfowl breeding areas supporting large breeding colonies of Sacred Ibis and Straw-necked Ibis, with smaller breeding colonies of Great, Intermediate and Little Egret and Yellow-billed Spoonbill. Several species colonise in a limited number of sites for breeding and roosting, and include Great Cormorant, Little Pied Cormorant, Darter, Rufous (Nankeen) Night Heron and Royal Spoonbill. Although most nesting sites are associated with water bodies, some occur in areas of regularly flooded forest. Surveys undertaken since 1993 indicate a considerable decline in breeding events for Rufous Night Heron, spoonbills, egrets and cormorants compared to previous records. This decline engenders concern for the long-term survival of such species and places particular importance on current breeding areas.

In addition the forest supports Pacific Heron, White-faced Heron, Australian Pelican, Black Swan, Pacific Black Duck, Grey Teal and Dusky Moorhen as well as crakes and rails. Other birds that commonly use the wetlands include the Clamorous Reed Warbler and Little Grassbird. During floods, open plains become covered in water, and attract flocks of Welcome Swallows and Tree Martins that feed on flying insects. White-bellied Sea-eagles and Marsh Harriers hunt over the swamps and wetlands (LCC 1983). Remnant areas of Moira grassland plains within the Ramsar site also provide important habitat for a number of waterbirds including the Spotless Crake.

The Barmah Forest Ramsar site also provides drought refuge for waterbirds, reflecting the prevalence of permanent water within the wetland system.

4.4 Natural function

The majority of Barmah Forest functions as a single floodplain wetland and is dependent on regular river flooding. Wetlands within the system range from permanent lakes and billabongs to shallow basins. The Barmah Forest Ramsar site provides habitat for a large number and diverse range of plants and animals. Other functions include organic carbon storage, water supply, groundwater recharge, maintenance of flow regimes and flood control (e.g. Barmah Forest forms a natural flood retardation basin with an estimated holding capacity of 32,100 ML).

4.5 Cultural heritage

The Barmah Forest Ramsar site contains many sites of cultural significance to the Aboriginal people. A survey of approximately 10% of the total forest area by Aboriginal Affairs Victoria in conjunction with the Yorta Yorta community identified 182 sites in the forest and suggests that the total number of sites in Barmah could exceed 2000. Sites identified include occupation sites, burial grounds, mounds, middens, scarred trees and stone artefact scatters (Bonhomme 1990).

As of July 2002, the site register at Aboriginal Affairs Victoria shows 13 shell deposits, 113 mounds, 114 scarred trees, 3 burial/human remains, 2 artefact scatters and 1 Aboriginal place as Aboriginal Cultural Heritage Places and 2 Aboriginal Post-Contact Places. A recent Aboriginal cultural heritage investigation was carried out at Barmah Island in conjunction with the Yorta Yorta Nations and Njernda Aboriginal Cooperative. Twenty two scarred trees and 17 middens were documented. The whole Ramsar site has not been adequately surveyed, so it is likely that more archaeological sites will be discovered.

A Native Title Determination Application by members of the Yorta Yorta Aboriginal Community was heard by the Federal Court in December 1998 which determined that Yorta Yorta had no continuous association with the land and therefore held no Native Title over the claimed land and waters. Yorta Yorta appealed to the Full Bench of the Federal Court, which, in February 2001, upheld the previous decision. In May 2002, Yorta Yorta appealed the Federal Court's decision before the Full Bench of the High Court, which in December 2002 upheld the Federal Court's decision.

Consultation between land managers and the local indigenous community needs to be enhanced in order to facilitate management of the site. In future, management agencies will establish or strengthen relationships with all relevant Indigenous communities.

To date there has been limited consultation between land managers and the local Indigenous community and further discussions need to take place in order to facilitate management of the site. It is important to recognise indigenous values in management practices, and that indigenous knowledge and connection to 'country' add significant input to management of the site. In future, management agencies will liaise with and involve all relevant Indigenous communities.

The range of non-indigenous historic places in the Barmah Forest Ramsar site reflects a number of different phases of European activity in the area. Relics of early European settlement are scattered around the Barmah Forest Ramsar site, however, most of the historical value is in the events that took place and the effect they had rather than what remains.

The Barmah-Millewa Forest incorporating the Ramsar site is listed on the Register of the National Estate in recognition of its importance as part of Australia's heritage and outstanding natural values. The forest contains a cultural landscape that reflects both Aboriginal and European activities.

4.6 Scenic

The Barmah Forest Ramsar site has high scenic values because of its large size and the diversity of natural and cultural landscape features contained in it. An important aspect of the landscape character of Barmah Forest, in particular, is the landscape diversity provided by the lakes, billabongs, rushlands, grasslands and box forest within the predominant stands of red gum (Leitch 1989). Significant landscapes are located along the Sand Ridge, Gulf and River Roads, and the Murray River (DCE 1992).

4.7 Economic

The components, functions and attributes of the Barmah Forest Ramsar site provide a variety of direct and indirect economic values to the area. Direct economic values of the Barmah Forest Ramsar site derive from timber production, domestic stock grazing, apiculture, extractive industry and the use of the area for recreation and tourism. In contrast, the natural functions of the Barmah Forest Ramsar site have important indirect measurable values that support or protect economic activities that have direct measurable values. The indirect economic values provided by the Barmah Forest Ramsar site include flood and flow control, nutrient retention, and water quality maintenance.

4.8 Education and interpretation

Information, interpretation and education assist enjoyment and foster understanding, appreciation and protection of Ramsar sites and their values.

The Barmah Forest Ramsar site receives a large number of visitors and is well suited to school camps. The Dharnya Centre, within the Barmah Forest Ramsar site, includes a visitor centre with an information display on cultural heritage, fauna, flora, and hydrology.

In addition, an interpretive sign is located near the Dharnya Centre produced as part of the Victorian Ramsar Wetlands Interpretation Project, which aims to promote understanding and gain community support for Ramsar sites and wetlands.

4.9 Recreation and tourism

The Barmah Forest Ramsar site attracts approximately 100,000 visitor days per year. The majority of visitors are attracted to the river environs. A wide range of activities including boating, fishing, scenic driving, 4WD driving, trail bike riding, cycling, horse riding and bushwalking are popular. Orienteering, picnicking, camping, canoeing, bait collection, duck shooting, hunting of feral animals and nature study are also undertaken (CFL 1990). The Barmah Forest is also a popular bird-watching site. Interpretive cruises of the lakes and forest highlight the abundant birdlife along with the ecology and history of the area.

4.10 Scientific

A number of research studies have been or are being undertaken at the Barmah Forest Ramsar site, particularly in the fields of forest ecology, floodplain ecology and hydrology. Parts of the State forest have been set aside from logging activities to conserve areas of undisturbed natural forest or areas with rare fauna and flora. They provide a comprehensive sampling of the river red gum ecosystem (MDBC 1992).

4.11 Condition

Vegetation

Changes in the vegetation of the forest have been well documented (for example: Chesterfield 1986; Bren and Gibbs 1988; Leitch 1989) and have been deduced by examination of historical and recent

evidence. The main factors influencing vegetation changes within the Barmah Forest Ramsar site have been the following:

- a reduction in frequency of burning following the displacement of Aboriginal tribes from the area;
- intense grazing by rabbits from the 1880s until their control by myxomatosis;
- grazing by domestic stock; and
- the effect of river regulation.

The condition of the flood plain vegetation is strongly influenced by flood timing, frequency, duration and depth. These parameters have altered since the construction of the two major storages, Hume Reservoir and Dartmouth Reservoir, with consequent changes in the botanical associations of floodplain communities (Chesterfield 1986, Bren and Gibbs 1988).

The site quality of red gum provides a good indication of water availability under natural conditions, as many of the mature trees grew before regulation of Murray flows reduced their water supply. The distribution and condition of the shorter-lived understorey species are more strongly influenced by recent watering conditions (MDBC 1992).

Moira Grass occurs in all mainland states of Australia and extends throughout Asia (Willis 1970). At their southern most limits in northern Victoria, the Moira Grass plains occur most extensively in Barmah Forest (Ward et al. 1994). Changes in the Moira Grass plains have been one of the more significant longer-term ecological changes in the forest. These changes first became apparent about three decades ago and have lead to substantial extinction of this interesting ecosystem (Chesterfield 1984).

Prior to 1934, Moira grassland plains covered 13.5% of the forest area (Chesterfield et al. 1984). They had been reduced to only 5.2% in 1988 (Bren and Gibbs 1988). Some former Moira Grass plains have developed into rushlands because of prolonged flooding resulting from higher river levels in summer and autumn; whereas others have been encroached upon by river red gum seedlings where regulation has caused a reduction in flood frequency (MDBC 1987). Grazing by domestic stock and rabbits are other factors that may be implicated in the reduction of the Moira Grass plains in the forest (Chesterfield et al. 1984).

Chesterfield (1986) noted that the Yellow Box/Grey Box Woodlands within the Barmah Forest Ramsar site appeared to have changed extensively as a result of grazing and clearing activities. Grazing in drier years by kangaroos, cattle and rabbits has probably reduced the cover and diversity of shrubs on these areas (Chesterfield 1986).

Introduced species are common to this Yellow Box/Grey Box Woodlands association, possibly due to grazing disturbances by rabbits, kangaroos, cattle and horses (MDBC 1987).

The diversity of the understorey species is very low in River Red Gum forest with Moira Grass being the predominant species. Chesterfield (1986) observed that diversity is compromised due to the periods of inundation being incompatible for the growth of other dryland species.

It is probable that the common reed and native Cumbungi were much more prevalent until the introduction of cattle and alteration of water regimes (DCE 1992). Conversely, the non-palatable Giant Rush, which is also apparently favoured by the hydrological changes caused by river regulation, has become more widespread (Chesterfield et al. 1984).

Water quality

Forest flooding has also often been observed to alter the quality of water within the forest. Morrison (1989) described water during a trial release in December 1988 as being darkly coloured, less turbid and oxygen deficient as it passed through the floodplains.

Irrigation drainage has been identified as a major contributor of nutrients, especially phosphorous to waterways in the catchment (GBCMA 1998).

Several irrigation drains pass through Barmah and have the potential to severely impact on flora and fauna values particularly in the waterways within the forest area. Catchment mitigation strategies and water management structures and strategies aim progressively to minimise this risk.

The relatively cold temperature of impounded water may also be a factor impacting on the values within the forest.

5 Management of Risks

The key risks to the maintenance of environmental values at the Barmah Forest Ramsar site are discussed below. The risks include altered water regimes, salinity, pollution, pest plants and animals, inappropriate resource utilisation, recreation and erosion which were in some cases established prior to the listing of the site.

These risks result from activities in the wetland, on adjoining land and in the catchment. Protection of the site therefore requires an integrated approach. A wide variety of measures are being implemented at the Barmah Forest Ramsar site to deal with risks. They include planning, research, site works, catchment works and education. A brief summary of these measures relevant to each risk is provided.

5.1 Altered water regimes

Since the 1950s the quantity of water diverted from the Murray River for irrigation development has increased substantially, augmented by inter-basin transfers from the Snowy via the Snowy Mountains Scheme. The natural regime of river flow in the Murray has been progressively modified since 1934 with the construction of the Hume Reservoir (in 1934 with improvements in 1961) and Dartmouth Reservoir (in 1979). Under natural conditions (i.e.. a non-regulated water regime) substantial areas of Barmah Forest would flood in winter and spring in most years when flows in the Murray River were highest, and would dry during summer and autumn when river flows were at their lowest (Leitch 1989).

The construction of dams, weirs and other regulators has altered the natural hydrologic regime (Bren and Gibbs 1988). The storage of winter and spring catchment flows in the Hume and Dartmouth Reservoirs and their subsequent release in summer and autumn to meet downstream irrigation and water supply demands has:

- reduced the frequency, duration and extent of winter-spring floods;
- altered the timing of floods;
- increased the frequency of smaller summer floods;
- reduced variability in flood flows; and
- caused changes in the water temperature regime.

Alteration to natural flow regimes of rivers and streams has been listed as a potentially threatening process under the *Flora and Fauna Guarantee Act 1988*.

Under natural conditions, 70% of the forest would be flooded for an average of 2.9 months in 78% of years. Since regulation, this level of flooding is only experienced for an average of 1.3 months in 37% of years (Leitch 1989, Bren and Gibbs 1988). However, small localised flooding, covering less than 10% of the forest, occur at least eight times more frequently since regulation began (Chong and Ladson 2002) and this flooding is also much more likely to occur between December and April.

A further factor affecting the flooding of the forest is the presence of a series of earthen block banks, levees, and regulators that have been constructed over the past fifty years to regulate flows and control bank erosion. These structures have reduced the spread and drainage of floodwaters in some areas of the forest.

These hydrologic changes have adversely affected, to various degrees, habitats within the forests and associated fauna. Problems caused in some parts of the forest include poor tree health and growth rates and changes to the composition of rushlands, grasslands and forests.

The Forest Commission map of Barmah drawn in 1930 estimated that 13.5% (4,050 ha) of the area was open Moira Grass plain. The area mapped in 1979-80 by Chesterfield (1986) shows a reduction to 5.5% (1,650 ha) of the total area of Barmah Forest, a loss of approximately 2,400 ha. Chesterfield (1986) estimates that 1,200 ha of the Moira Grass plain has been lost to Red Gum regeneration and the remaining 1,200 ha to Giant Rush encroachment. In 1992, Bren noted that the Moira Grass plains have continued to decline in extent in the 12 years since Chesterfield's assessment.

There is concern that the Moira Grass plains will be rapidly lost to rushland and forest encroachment. Without active hydrological management, the inherent character of the treeless Moira Grass plains will disappear within one hundred years, with isolated remnant Moira Grass communities occurring only as an understorey component to Red Gum (Bren 1992), or converted to Giant Rush swamp (Ward et al. 1994, Reid and Brooks 1998).

Hydrological changes have reduced fish and waterbird populations and their breeding habitats, particularly those species dependent upon the flood waters. A decline in both the numbers and species of birds breeding has been documented, particularly over the last 30 years (Chesterfield et al. 1984, Leslie 1988). Much of this change has been attributed to

changed hydrological conditions, as flooding is required to provide suitable conditions for nesting, and also sufficient productive feeding areas for successful rearing of young. It must be noted that the lack of flooding is not the only impact that has occurred on colonially nesting birds. The lack of a drying phase in some of the low lying wetlands, and the consequent change in vegetation, has disadvantaged many species, notably the grebes, terns, coots, avocets and stilts (Leslie 1998).

These species nest on floating aquatic plants in shallow water, which have been largely replaced by giant rush on lake and swamp margins.

The Sandpit and Gulf Regulators, in particular, both pass rapid flows into major forest creeks. They are suspected of being a major barrier to native fish migration, preventing fish from returning to the river when creek levels fall and the regulators are closed. Monitoring of fish movement in the forest creeks has commenced to determine the need for fishways or the change in operation of regulators.

In extensive and prolonged flood events, deoxygenation of water can occur rapidly when floodwater is prevented from continually flowing across the floodplain. This can lead to fish kills. This risk is increased by presence of earthen block banks to pond water on the floodplain (McKinnon 1997).

Reptiles and amphibians may be vulnerable to the effects of unseasonal flooding in summer, through egg mortality of tortoises, terrestrial lizards and snakes. There may also be a direct effect on the survival of terrestrial species sheltering in low-lying areas (MDBC 1992).

The Gum-leaf Skeletoniser is a major defoliant of River Red Gum in the mid-Murray area and outbreaks are linked to inappropriate flooding regimes. Infestations occur when the absence of flooding coincides with the larvae stage. Defoliation rarely if ever results in tree mortality, but growth is temporarily retarded (Von Mueller Institute 1986). Twelve outbreaks have been recorded since 1969, with up to 40,000 ha defoliated on at least two occasions in the Murray area (DCE 1992). The most recent outbreak was recorded in 1995.

Rising watertables and salinity may pose a greater risk to the forest in the future due to the trend of rising watertables in areas surrounding the Barmah Forest Ramsar site. The water table south of the forest is generally within two metres of the surface and is expanding northwards (DCE 1992).

The site has a complex water distribution, and further study is necessary to determine water movement throughout the forest. Such studies would assist in the management of environmental water allocations used in the forest.

The impacts associated with altered water regimes are being addressed by scientific studies into the hydrology and biology of Barmah Forest, and the development of the Water Management Plan for Barmah Forest. The issues were also examined as part of the Bulk Water Entitlement process for the Murray River, which is now complete and has resulted in environmental water provisions for the Barmah-Millewa Forest and for Murray River wetlands generally.

An annual allocation of 100 GL (50 GL each from Victoria and NSW) was initially made by the Murray-Darling Basin Commission to the Barmah-Millewa Forest in 1993. In 1999, the Victorian Government formally established (by Orders in Council) Victoria's share of the environmental water allocation for the Barmah-Millewa Forest, which includes the following (NSW contributes an equal amount for each allocation):

- 50 GL per year of high security water with a provision that the unused amount may be accumulated from year to year (subject to storage space in the Hume and Dartmouth Reservoirs and a maximum volume which can be accrued).
- 25 GL per year of low security water that can be accumulated from year to year subject to storage space in the Hume and Dartmouth Reservoirs and a maximum volume which can be accrued.

In addition to the environmental water allocation specifically for Barmah Forest, there is access to 25,000 of the 27,600 ML Flora and Fauna Bulk Entitlement of high security water to enhance the flora and fauna in Northern Victoria. Part of this entitlement was used to augment flood events and other environmental releases into Barmah Forest in 2000 and 2001.

The first use of the Barmah-Millewa environmental water allocation was made in 1998 when 97.4 GL was provided to supplement a minor flood in the forest caused by high flows in the Ovens River. The second and largest use of the Barmah-Millewa environmental water allocation commenced in October 2000 to prolong biological processes stimulated by the best natural flooding for several years (i.e.. major bird breeding events, fish breeding and growth of aquatic flora). A total volume of 341 GL was released to prolong forest watering during this watering event, including a supplementary amount of 41 GL from other NSW wetland environmental allocations and the Victorian Flora and Fauna Bulk Entitlement. This allowed watering to continue to late January 2001.

The water was used on three specific occasions throughout the natural flood event:

- The first was in October 2000 following draw-down of a large natural flood event that originated in the Ovens River system in September. Fortunately a second larger peak occurred one week later with the spilling of Hume Reservoir, resulting in widespread natural flooding until late November 2000.
- The second was to reduce the rate of draw-down at one period in mid-November 2000 in an attempt to minimise possible abandonment of nesting waterbirds.
- The third and most extensive use of the remaining volume of the environmental water allocation then occurred following flood subsidence in late November 2000 until late January 2001 to ensure successful breeding of a wide diversity of waterbirds (notably Egrets).

Excellent results were obtained for breeding waterbirds and broader wetland ecology that would not have otherwise occurred to the same extent without the supply and good management of the environmental water allocation. Bird breeding success was ranked as a 1 in 10 year event, with some species having bred in the forest for the first time in the last 30 years.

Successful management of water regimes in Barmah Forest will require ongoing understanding of several issues: the complex pattern of water movement; the relation of flood levels to water volumes; the importance of connectivity between the river and the floodplain; and the responses of plant and animal communities to flooding regimes.

Decision-making regarding the management of environmental water is facilitated by the Barmah-Millewa Forum, a formal community and agency partnership established under the Murray-Darling Basin Agreement to oversee the implementation of the Murray-Darling Basin Commission Water Management Strategy (MDBC 2000). The Forum is responsible for developing an annual plan, which includes proposals for the best use of environmental water, works programs and research.

In the wider context, concerns about the health of the Murray River, security of water supply for existing irrigators and reduced reliability of water supply during long droughts lead the Murray-Darling Basin Ministerial Council to impose a cap on irrigation diversions in 1997. *The Living Murray* is a current Murray-Darling Basin Commission initiative about restoring the health of the River Murray and the Murray-Darling Basin.

5.2 Pollution

There are a number of effluent creeks and drains flowing into the forest and wetlands from surrounding private agricultural properties. These creeks and drains may introduce additional nutrients, pesticides, herbicides and weed species.

Sedimentation in the wetland areas of the Barmah Forest appears to have increased (Leitch 1989). A number of wetlands in the forest, in particular Top Island and Barmah Lakes, appear to be silting up very rapidly (Leitch 1989). This means higher rivers are necessary to effectively flood these areas. Although siltation is a natural process, the rate of sediment build-up seems to have accelerated over recent years (DCE 1992).

Until the rate of sedimentation accumulation is resolved, any conclusions about contributing factors are premature. However, the presence of various vegetation associations and the drainage of floodwaters can influence the quantity of sediment deposited during an overflow flow event. Plants like Giant Rush and sedges on floodplain areas experience twice the amount of sediment accumulation in comparison to grassland areas (Thoms and Walker 1993).

The impacts associated with pollution are being addressed principally through the implementation of the Goulburn Broken Catchment Water Quality Strategy (GBWQWG 1997), which is currently under review. The strategy does not deal with the sedimentation issue within Barmah. Salinity and watertable issues are being dealt with under the Shepparton Irrigation Region Land and Water Management Plan.

5.3 Pest plants and animals

The flora of the Barmah Forest Ramsar site consists of more than 550 recorded species, of which approximately 30% are exotics. Both the former Land Conservation Council (1983) and the Department of Conservation and Environment (1992) recognised that the distribution of weeds within Barmah State Forest is widespread. The main exotic species include Paterson's Curse, Golden Dodder, St John's Wort, Blackberry, Horehound, Bathurst Burr, Spiny Burr-grass, Willow, Honey Locust, Fennel, Noogoora Burr, Sweet Briar, Caltrop, Skeleton Weed, Arrowhead and Slender Thistles.

The pest plants reduce opportunities for regeneration of indigenous flora through competitive growth and by changing soil conditions required for successful germination and growth and provide harbour for pest animals and invertebrates that may feed on or predate indigenous flora and fauna.

Although most depend on disturbances such as grazing or the movement of machinery to provide the conditions under which they out-compete native species, some have been assisted by flooding and the dispersal of seed and other propagules by water.

A number of introduced animals have been recorded in the Barmah Forest Ramsar site. Problem species include rabbits, foxes, horses, wild pigs, cats, and carp.

Rabbits are distributed throughout the Barmah Forest Ramsar site but populations are controlled through regular flooding.

Predation of native wildlife by foxes and cats are listed as threatening processes under the *Flora and Fauna Guarantee Act 1988*. Foxes and cats have been identified in the Barmah Forest Ramsar site. The following categories of native fauna are considered to be at risk from predation:

- arboreal mammals including Brushtail and Ringtail Possums;
- bird species that spend much of their time at or near the ground nesting and/or feeding including the Bush Thick-knee, Ground Cuckoo-shrike and King Quail; and
- reptiles such as the Carpet Python.

Foxes also feed on tortoise eggs, and since tortoises are long-lived, the impact of this predation may not be noticed until there is a sudden population decline (DCE 1992).

Low numbers of wild horses are present in the forest, with estimates varying from 100 to 300 animals but no accurate figures are available. Horses tend to crop vegetation to the ground when grazing and can have a dramatic impact on palatable native species. These are the progeny of some of the former workhorses that were turned out in the forest after harvest periods (Dexter 1978).

The feral pig population in the forest is estimated to be in the low hundreds. Feral pigs cause localised soil disruption, muddy waterholes and disturb understorey vegetation (DCE 1992). An annual control program and recreational hunting assist in controlling the feral pig population.

The regulation of the river, modification of habitat and the decline in native fish numbers are likely causes of the rapid spread and abundance of carp (Stuart et al. 2001). Some movement tracking has indicated that carp are highly mobile but remain on the Barmah floodplain during their spawning season in spring/summer. Capture numbers indicate that the Barmah-Millewa floodplain is a major source of recruitment of carp, and provides the opportunity for point source control of carp that would be of benefit to the broader region. An investigation will be undertaken to determine whether adult carp can be physically blocked from the floodplain, water levels manipulated to disrupt spawning and congregated fish commercially harvested.

If this investigation on point source control proves successful, a comprehensive carp control plan will be developed with concentration on off-stream habitats (Stuart and Jones 2001).

The presence of feral honeybees in the Barmah Forest Ramsar site may pose a threat to native flora and fauna arising from their use of nesting hollows and floral resources. This has been listed as a potentially threatening process under the *Flora and Fauna Guarantee Act 1988*. For information on domestic bee-keeping (i.e.. apiculture) within the Ramsar site refer to Section 5.4.

The risk of pest plants and animals is being addressed through a range of measures including rabbit harbour destruction, fox baiting, spraying programs to contain and as far as possible eradicate pest plants from the Ramsar site. A cross tenure approach to pest plant and animal control is required if control programs are to be successful.

5.4 Resource utilisation

The *National Parks Act 1975* and the *Forests Act 1958* allow for resource utilisation in the Ramsar site. Such utilisation includes forestry for timber (in the State Forest), grazing and apiculture.

Timber harvesting

Extensive logging has been carried out in the Barmah Forest Ramsar site since the 1860s. It has been estimated that 2.5 million m^3 of River Red Gum logs have been harvested since that time. The *Forests Act 1958* provides for the licensed removal and sale of forest produce in the State Forest. Timber harvesting was allowed within the State Park up until June 2003.

The Forest Management Plan for the Mid-Murray Forest Management Area (NRE 2002b) provides figures on timber produced from Barmah in 2000/2001. In total, 2,631 m^3 of sawlogs, 842 m^3 of sleepers and 1,056 m^3 of residual logs (low grade logs that sometimes become available as a by-product of sawlog and sleeper harvesting and regrowth management operations) were removed from the forest during this period.

The range of wood products derived from the forest includes heavy construction timbers, railway sleepers, house stumps, furniture timbers, flooring, feature panelling, poles, fence posts, firewood and charcoal. River Red Gum is the only species harvested. Yellow Box, Grey Box and Black Box are not harvested (NRE 2002b).

Sawlogs are supplied in accordance with the sustainable yield rate for the Mid-Murray Forests. The current sustainable yield rate for the whole Mid-Murray Forest Management Area, which includes Barmah Forest, is set at 5,600 m^3 per year. As the result of a review of sawlog licences conducted in 2001 sawlog licences will be reduced to 5,200 m^3 per year, in accordance with the principles outlined in Our Forests, Our Future (NRE 2002e).

Past timber harvesting and silvicultural practices in the Barmah Forest have altered the age structure of the forest. Loss of hollow-bearing trees and habitat fragmentation are threatening processes of particular relevance to the forests of the central Murray region (Bennett et al. 1994). The Forest Management Plan for the Mid-Murray Forest Management Area (NRE 2002b) outlines enhancement measures for structural diversity by retaining habitat trees (including hollow-bearing trees) according to local prescriptions, low intensity harvesting using single-tree or group selection and the continuation of special protection zones where timber harvesting is not undertaken.

Under the Forest Management Plan for the Mid-Murray Forest Management Area (NRE 2002b), Special Protection Zones (SPZ) and Special Management Zones (SMZ) have been established in Barmah State Forest to protect natural and cultural values. SPZ are managed for conservation and timber harvesting is excluded. Sustainable timber production is permitted in SMZ but under modified conditions directed towards conserving natural or cultural values. A SPZ has been established along several creeks and on some wetlands in Barmah Forest. A SMZ with a 50 metre wide buffer covers other water bodies and natural open wetland areas, such as the Moira Grass plains.

The remainder of the State Forest is a General Management Zone managed for the ecologically sustainable production of timber and other forest products. Timber harvesting is conducted in accordance with the 'Code of Forest Practices for Timber Production. Revision No. 2' (NRE 1996).

Fallen timber is a major habitat structural element for plants and animals. A recent study on the depletion of fallen timber (MacNally et al. 2002) found that fallen timber volumes have decreased significantly from natural levels in River Red Gum Forests of the southern Murray-Darling Basin and that this has negative implications for biodiversity. Causes of depletion are attributed to firewood collection, fuel reduction and silvicultural management. The study suggests restoration targets of 40-50 tonnes per hectare. . The Mid-Murray Forest Management Plan includes guidelines for firewood harvesting and collection to minimise depletion of woody debris.

Grazing

Grazing is carried out within the Ramsar site according to grazing licences issued under the *Forests Act 1958* and a water frontage licence issued under the *Land Act 1958* (DCE 1992).

Four grazing licences and one water frontage licence cover areas within the State Park. Two grazing licences are held over areas of State Forest. Continuation of grazing in these areas requires licences to be issued under the *National Parks Act 1975*. The Department of Sustainability and Environment (DSE) offers members of two grazing associations (Barmah and Yielima) agistment for cattle on two segments of the forest.

Cattle quotas for summer and winter seasons are determined by DSE on the advice of the Barmah Forest Grazing Advisory Committee, which was established under Section 32F of the *National Parks Act 1975*. Agistees grazed between 1,000 - 2,000 cattle in summer and 300 - 700 cattle in winter.

Grazing by cattle within the Barmah Forest Ramsar site can be a significant threat to the wetlands. Problems caused by cattle within the Barmah Forest Ramsar site include:

- alteration of the species composition with perennial species being replaced with ephemeral or annual species, changes in photosynthetic pathway, domination of annual and introduced species and an increased presence of species capable of being dispersed by stock (SFNSW 2000);
- structural changes in growth form (e.g. open grasslands to shrublands) and changes in age class representation (SFNSW 2000);
- changes in function of the landscape contributing to leaky soils, water logging, salinity and acidity problems (SFNSW 2000); and
- stock grazing is also recognised as a major risk factor for woodland birds, amphibians and ground invertebrates. In areas managed for conservation and production, much greater attention needs to be placed on ecological factors such as species diversity (SFNSW 2000).

Grazing areas in Barmah Forest contain environmentally sensitive sites such as wetlands, riverbanks, sandhills and box woodlands. A strategy for native forests in the Riverina in NSW (SFNSW 2000), which would be applicable to Barmah Forest, outlined measures to more fully protect these areas, including:

- fencing of environmentally sensitive and high value sites to exclude livestock grazing;

- where fencing is not practical, the grazing regime should be set by the most sensitive environmental; and
- the grazing of wetlands should not be undertaken until sediments are dry and water plants have flowered and set seed (SFNSW 2000).

Management strategies such as fencing and applying appropriate grazing regimes are also applicable for cultural site management. Grazing and trampling by livestock can degrade and erode sensitive cultural sites. Some areas such as sandhills, surface scatters and burial mounds are highly culturally sensitive.

Where fencing is used, it should be designed to minimise risk to waterbirds and other fauna by avoiding use of barbed wire and ensuring the top wire is highly visible where a fence crosses a waterway or flight lane.

Detailed research is clearly required into the effects of grazing on the different vegetation communities and habitats in Barmah Forest, and into the role for grazing to reduce fire fuel loads (Ward 1991).

The Forest Management Plan for the Mid-Murray Forest Management Area establishes guidelines and actions for managing grazing in the State Forest.

Apiculture

Apiculture is permitted in both the Barmah State Forest and State Park. Apiary sites in the State Forest are administered under the *Forests Act 1958*, while sites in the State Park may be permitted under the *National Parks Act 1975*, consistent with LCC recommendations for the Murray Valley Area. A maximum of 11 sites are permitted throughout the State Park and are located where it is considered to not conflict with management objectives. The apiary sites within the State Forest are regulated under a licensing system of either annual (12 month) or temporary (3-6 month) licences.

Studies suggest that honeybees may both adversely and positively affect native ecosystems (Paton 1996), although the degree of these effects has not been evaluated. Competition for resources such as nectar and pollen by introduced bees may result in displacement of native fauna, causing a long-term decline in native pollinator populations. Occupation of hollow-bearing trees by feral honeybees is of concern as the supply of hollow-bearing trees is limited in the Ramsar site.

Effects of honey bees on native flora may include hybridisation of plant species, inefficient pollination and the enhancement of seed production of some native plants whose native pollinators have declined substantially. The extent and impact of increased competition between introduced honeybees and indigenous fauna in the Barmah Forest Ramsar site is currently unknown and further research is needed.

Large bee populations can interfere with recreational activities (NRE 2002b). As a result, apiculture is not permitted near major recreational sites (distances will vary with local conditions).

5.5 Recreation

The Barmah Forest Ramsar site is a popular destination for people from Melbourne and regional centres in the Murray Valley such as Shepparton and Echuca. The major attraction is the Murray River, which is the focus for most recreational activities. The wetlands and River Red Gum forests are other features of recreational importance.

Visitor use is primarily concentrated along the river at numerous picnic and camping areas. The importance of the forest to tourism and recreation is reflected in the number of visitors. Annual visitor statistics calculated in camper nights is 60,000 for Barmah Forest.

The impact of recreational activities is influenced seasonally and some activities pose a threat to the environmental values of the wetlands. Recreational activities can also impact negatively on Aboriginal cultural heritage values.

Camping is a popular activity along the Murray River. However, the overuse of existing camping sites and ad-hoc creation of new sites has lead to excessive vegetation damage, soil compaction, erosion of riverbanks and issues associated with rubbish disposal (DCE 1992). The collection of firewood by campers can also result in the loss of habitat for fauna and destruction of small trees and shrubs around campsites and along access roads.

Hunting of duck, fox, rabbit, and pigs is permitted in the State Forest at Barmah. The impacts of hunting on site values have not been determined, however, hunting can create both physical and noise disturbance to fauna and result in the accidental shooting of protected species.

Contamination of wetlands from the accumulation of lead shot is listed as a threatening process under the *Flora and Fauna Guarantee Act 1988*. Lead shot was prohibited for duck hunting in Victoria in 2002 but can still be used for hunting quail, pest animals and for clay target shooting. Waterbirds, which feed in or on the edges of wetlands, are still at risk of lead poisoning due to residual lead in sediments (FFG Action Statement No. 32). The extent of the lead contamination in the Barmah Forest Ramsar site is not known.

Other indirect but localised impacts from hunting include litter (including spent shells) and disturbance to shoreline vegetation from camping, trampling and hide construction.

Trail bike riding throughout the forest causes some localised damage to soil and vegetation and is most evident along the river, particularly at heavily used camp sites. Off road horse riding can contribute to the spread of weeds, damage soil and vegetation, especially in wet areas, and promote track establishment (DCE 1992). Campers, day visitors and hunters also bring domestic dogs into the forest, which can have an impact on native wildlife. Dogs are not permitted in Barmah State Park (DCE 1992).

The risks associated with recreation are being addressed through a range of measures. These measures include: a significant enforcement and monitoring presence during duck season, the enforcement of fishing regulations dealing with fish size and catch limits and the development of visitor interpretation and education programs.

5.6 Erosion

Erosion of the banks of the Murray River has been identified as a particular risk for the longer-term management of water in the forest, requiring water operations to minimise the problem and development of management actions to prevent further erosion (MDBC 1999). Erosion has the potential to impact negatively on Aboriginal cultural values as well as natural values.

At many locations along the river, erosion of the bank appears to be occurring at an unnaturally rapid rate. Studies based on bed and bank surveys carried out in 1876 and 1976 suggest that the river is in general becoming broader and shallower (Lodger and Bayley 1988). Whether this process has been caused by changes in the flow regime or other agencies of human origin is unknown. The continually higher river levels necessary to satisfy irrigation demands may cause increased erosion.

Boat wash has been implicated as a major contributing factor to increased erosion rates along the Murray River (DCE 1992).

5.7 Fire

Fire management on public land in Victoria is governed by the Code of Practice for Fire Management on Public Land (CNR 1995). The North East Fire Protection Plan (in prep.) covers the Shepparton Fire District where Barmah Forest is located. The plan defines fire protection objectives, strategies and practices to be adopted in the management of wildfires and prescribed burning.

Under the Fire Protection Plan the Barmah Forest Ramsar site is classified as Zone 3 for fire fuel management purposes. Zone 3 and 4 areas are managed specifically to provide an irregular mosaic of areas of fuel reduction to complement works in Zones 1 and 2 to reduce the severity of wildfires, and for broad ecological management objectives.

Intense fire can be catastrophic for River Red Gums, which rely on seasonal flooding rather than fire for regeneration. The two reference areas within the Ramsar site are classified as Zone 5, which excludes prescribed burning where there would be a high potential for economic, ecological or cultural loss if they were subject to fire.

In most years high fire danger conditions occur throughout summer in the forest. Between 1972-73 and 1986-87, 67 fires burnt a total area 1195 ha in the forest. The largest fire in this period burnt approximately 200 ha, and 50 of the fires covered 10 ha or less. Eighty-one percent of fires occurred between November and April. Fire suppression methods are well established for the area, and most fires are quickly extinguished.

The risk of fire is being addressed through the implementation of the Code of Practice for Fire Management on Public Land (1995) and the Interim Guidelines and Procedures for Ecological Burning on Public Land in Victoria (1999). Combined these documents provide a consistent framework and process for planning and implementing ecological burning programs by DSE and Parks Victoria.

5.8 Level of risk to Ramsar values

The goal of the integrated management framework (incorporating the Strategic Directions Statement and corresponding Strategic Management Plans) is to facilitate the maintenance of ecological character at Victoria's Ramsar sites by minimising risks to values. This goal will be achieved through the implementation of strategically prioritised management actions. Management actions are prioritised according to their ability to address the identified risks.

A *strategic risk assessment* process based on the broad concepts and principles of ecological risk assessment has been undertaken for the Strategic Directions Statement and Strategic Management Plans (NRE 2002a – Appendix 7). This process relied on a clear understanding of the range of direct and indirect pressures facing the wetlands, as well as the legislative and policy context.

Such a systematic and strategic analysis of risk provides the necessary information to site managers; and facilitates priority setting, resource allocation and informed decision-making. This form of analysis also provides a better understanding of management issues.

The strategic risk assessment process has established the basis for objectively assigning higher, medium and lower priority levels to risks at Ramsar sites and the management actions designed to address them. The strategic risk assessment approach also facilitates an understanding of the relationship between specific risks and values. The strategic risk assessment framework draws on two major relevant documents: the US Environment Protection Authority's Guidelines for Ecological Risk Assessment (1997), and the Ramsar Convention's Wetland Risk Assessment (1999).

The main risks to the environmental values and ecological character of the Barmah Forest Ramsar site are summarised in Table 5.1. It should be noted that the level of risk has not been assessed against the effort currently being applied to mitigating the risk.

Table 5.1 Level of risk to the ecological character of Barmah Forest Ramsar site

	Risks								
	Altered water regimes	Salinity	Pollution	Pest plants	Pest animals	Resource utilisation	Recreation	Fire	Erosion
Barmah Forest Ramsar site	◆◆◆	◆	◆	◆◆	◆◆	◆◆	◆◆	◆◆	◆

◆◆◆ **Higher priority risk** - risks that currently or may potentially result in the significant loss of the site's environmental values and ecological character.

◆◆ **Medium priority risk** - risks that currently or may potentially result in the moderate loss of the site's environmental values and ecological character.

◆ **Lower priority risk** - risks that currently or may potentially result in the minor loss of the site's environmental values and ecological character.

6 Site Management Strategies

A number of Site Management Strategies have been developed in response to the analysis of risks to the values at the Barmah Forest Ramsar site. The Site Management Strategies are grouped under the relevant Management Objectives established by the Strategic Directions Statement.

The Site Management Strategies for the Barmah Forest Ramsar site promote a range of specific management actions that will maintain, and in some cases restore the ecological character of the site. The Site Management Strategies are designed to:

a) address risks that are having an adverse impact, or are likely to have an adverse impact on ecological character; and

b) highlight existing strategies and actions that are consistent with wise use principles.

The successful coordination and cooperation of the lead agencies, as well as the continued efforts of the many community and interest groups, is essential for the long-term conservation of the Barmah Forest Ramsar site. The Strategic Directions Statement, statutory mechanisms, management plans and management strategies will guide the implementation of this Strategic Management Plan.

The Department of Sustainability and Environment will have overall responsibility for:

- facilitating the implementation of the Strategic Directions Statement and Strategic Management Plans for Ramsar sites by ensuring relevant agencies incorporate relevant strategies into their work programs;
- coordinating and reporting on the progress and/or issues with implementation of the Strategic Directions Statement and Strategic Management Plans for Ramsar sites;
- ensuring monitoring programs are established in accordance with the Strategic Directions Statement and Strategic Management Plans for Ramsar sites;
- ensuring the regular review of Strategic Management Plans for Ramsar sites;
- preparing the Victorian chapter of Australia's National Report to triennial Conferences of the Contracting Parties to the Ramsar Convention; and
- the six yearly update of the Ramsar Information Sheets for each site.

In order to clarify accountabilities, the lead agency responsible for the implementation of each strategy is identified. Lead agencies will monitor implementation of the strategies for which they are responsible. Lead agencies are encouraged to record progress on their responsibilities and extent of implementation and provide information in the form of annual summary reports to the Department of Sustainability and Environment (DSE). This information will be consistent with a format developed by DSE and will contribute to Victoria's chapter in the National Report to the Convention on Wetlands, prepared every three years.

A rating of relative priority accompanies each Site Management Strategy. Definitions of these priorities are as follows:

Higher: Strategies that, when implemented, will significantly contribute to the maintenance of ecological character.

Medium: Strategies that, when implemented in conjunction with Higher priority strategies, will support the maintenance and contribute to the restoration of ecological character.

Lower: Strategies that, when implemented in conjunction with Higher and Medium priority strategies, will result in enhancement of ecological character.

Management Objective 1

Increase the scientific understanding of wetland ecosystems and their management requirements

	Site Management Strategy	Lead agency	Priority
1.1	Seek funding for research needed to determine more appropriate water regimes for the Ramsar site based on the hydro-ecological requirements of the forest.	DSE, GBCMA, PV	Higher
1.2	Seek funding for studies, which determine the complexity of water movement throughout the forest to assist in the management of environmental water allocations.	DSE	Higher
1.3	Complete the program to monitor fish movement in the forest creeks and determine the impact of regulators on fish passage.	DSE	Higher
1.4	Seek funding for research into the causes of erosion along the banks of the Murray River and develop strategies to minimise the extent of this erosion.	PV	Higher
1.5	Encourage and seek funding for research into the rate and mechanisms of sediment deposition.	DSE, PV	Medium
1.6	Assist and encourage surveys and research into natural and cultural values of the Ramsar site.	DSE, PV	Medium
1.7	Seek funding for research into the effects of grazing on vegetation communities and its role in reducing fire fuel loads.	DSE	Medium
1.8	Initiate research and monitoring of the impacts of apiculture on native flora and fauna within the Ramsar site.	DSE	Medium
1.9	Seek funding for an investigation of the extent of wastewater pollution of Barmah Forest.	GMW, GBCMA	Lower

Management Objective 2

Maintain or seek to restore appropriate water regimes

	Site Management Strategy	Lead agency	Priority
2.1	Ensure that environmental water allocations are used in accordance with management plans and strategies and that monitoring is undertaken to improve understanding of the effects of water management regimes.	DSE, PV, GBCMA	Higher
2.2	Seek funding for mapping and investigating flows and water quality of formal and informal drainage schemes draining into the Ramsar site.	GBCMA, DSE, GMW	Higher
2.3	Finalise and implement the Water Management Plan for Barmah Forest (which will replace the Interim Water Management Strategy 1994).	GBCMA, DSE, PV	Higher
2.4	Ensure a priority water management works program is submitted annually to the MDBC Barmah-Millewa Forum process.	DSE, PV	Higher

Management Objective 3

Address adverse processes and activities

	Site Management Strategy	Lead agency	Priority
3.1	Implement the State Environment Protection Policy - Waters of Victoria (EPA 2003) as it relates to water quality in the Barmah Forest Ramsar site.	EPA	Higher
3.2	Implement the Goulburn Broken Catchment Water Quality Strategy and the Shepparton Irrigation Region Land and Water Management Plan as they relate to water quality and pollution discharge.	GBCMA, DSE, DPI, PV, GMW	Higher
3.3	Coordinate appropriate consents for use and development on adjacent land under the *Planning and Environment Act 1987* and during the Environmental Effects Statement process (*Environmental Effects Act 1978*).	Shire	Higher
3.4	Manage fire in accordance with the Code of Practice for Fire Management on Public Land (1995), Interim Guidelines and Procedures for Ecological Burning on Public Land in Victoria (1999) and the Draft North East Fire Protection Plan.	DSE, PV	Higher

Management Objective 3 continued

	Site Management Strategy	Lead agency	Priority
3.5	Ensure that the environmental values of Barmah Forest, including its Ramsar status, are recognised and included in the Shire of Moira Planning Scheme.	Shire	Higher
3.6	Comply with the *Reference Areas Act 1978* and guidelines for management in Top Island and Top End Reference Areas.	PV	Higher
3.7	Ensure all applications for amending land use and development in the water catchments surrounding the Barmah Forest Ramsar site are referred to CMAs, DSE, AAV, Yorta Yorta and Parks Victoria to ensure potential impacts are identified and appropriately addressed.	Shire	Higher
3.8	Ensure proponents are made aware that development proposals that may impact on Ramsar values should be referred to Environment Australia or an approved State authority as directed by the EPBC Act 1999.	DSE, PV, Shire, GBCMA	Higher
3.9	Prepare and implement priority pest plant and animal control programs in conjunction with adjacent landholders, in accordance with the Mid-Murray Forest Management Plan and strategies and Action Plans developed by the CMA.	DSE, DPI, PV	Higher
3.10	Assess impacts of land use and development adjacent to the Ramsar site on Ramsar site values. If necessary, seek planning scheme amendments, such as re-zoning or placing an environmental significance overlay on adjacent land to minimise impacts.	DSE, GBCMA, Shire	Lower

Management Objective 4

Manage within an integrated catchment management framework

	Site Management Strategy	Lead agency	Priority
4.1	Ensure this strategic management plan is recognised in the Goulburn Broken Regional Catchment Strategy planning and implementation framework and that catchment plans complement this plan to promote the protection of Ramsar site values.	GBCMA	Higher
4.2	Ensure pest plant and animal control efforts are coordinated across all land tenures in line with CMA strategies.	DSE, DPI, PV, GBCMA	Medium

Management Objective 5

Manage resource utilisation on a sustainable basis

	Site Management Strategy	Lead agency	Priority
5.1	Where practicable, construct fences to prevent access by stock to areas of significant cultural and environmental value. Ensure fence design is developed in consultation with the Yorta Yorta Nations and other relevant stakeholders. If fencing is not practicable, manage grazing regimes to minimise impact on the most sensitive environmental and cultural values.	DSE, PV	Higher
5.2	Review grazing licences and develop grazing management strategies for licensed areas in consultation with licensees and in accordance with the Mid-Murray Forest Management Plan and Barmah State Park and Forest Plan.	DSE, PV	Higher
5.3	Develop a routine assessment process to assess the ecological condition of the grazing areas to improve the ability to manage stock numbers if seasonal conditions or ecological requirements dictate.	DSE, PV	Higher
5.4	Ensure timber resource utilisation is conducted in accordance with the Code of Forest Practices for Timber Production, the Forest Management Plan for the Mid-Murray Forest Management Area and ecologically sustainable forest management principles.	DSE	Higher
5.5	Manage apiculture in accordance with standard licence conditions and according to the Mid-Murray Forest Management Plan	DSE, PV	Medium

Management Objective 6

Protect and where appropriate enhance ecosystem processes, habitats and species

	Site Management Strategy	Lead agency	Priority
6.1	Manage the habitat of threatened flora and fauna species in line with the Victorian Riverina Bioregional Network priorities.	DSE, PV	Higher
6.2	Manage flora and fauna, including threatened, migratory and colonially nesting bird species according to FFG Action Statements, the Mid-Murray Forest Management Plan and Barmah State Park and Forest Plan.	DSE, PV	Higher
6.3	Protect, maintain and regenerate the remaining areas of Moira grassland plains in accordance with the Mid-Murray Forest Management Plan and Barmah State Park and Forest Plan.	DSE, PV	Higher
6.4	Continue monitoring of fish movement in the forest creeks as required to determine the need for fishways or the change in operation of regulators that impede fish movement.	DSE, PV	Medium

Management Objective 7

Encourage strong partnerships between management agencies

	Site Management Strategy	Lead agency	Priority
7.1	Establish and maintain regular communication and links between all relevant Barmah Forest management agencies and key organisations such as GBCMA, GMW and Shire of Moira.	DSE, PV	Higher
7.2	Continue to work with the Murray-Darling Basin Commission, State Forests of New South Wales and the New South Wales Department of Infrastructure, Planning and Natural Resources to maintain a formal process for the allocation and management of environmental and rain rejection flows between Barmah and Millewa Forests.	DSE, PV	Higher
7.3	Ensure effective Victorian representation in the MDBC Barmah-Millewa Forum process.	DSE, GBCMA, GMW, PV	Higher
7.4	Continue ongoing engagement with local Indigenous communities in the management of Aboriginal cultural heritage values, as outlined in the Mid-Murray Forest Management Plan.	DSE, PV	Higher
7.5	Ensure ongoing consultation with the Yorta Yorta Nations and their involvement in all facets of Ramsar site management, consistent with the commitment of the Indigenous Partnership Strategy to recognise the fundamental role Aboriginal indigenous communities have in natural resource management.	DSE, PV	Higher
7.6	Consult with local Aboriginal people to ensure that other site management strategies in this plan do not adversely impact on Aboriginal cultural heritage values.	DSE, PV	Higher

Management Objective 8

Promote community awareness and understanding and provide opportunities for involvement in management

	Site Management Strategy	Lead agency	Priority
8.1	Promote community participation in habitat protection and enhancement works.	DSE, PV	Higher
8.2	Promote greater understanding, awareness and protection of the Barmah Forest Ramsar site to landholders and the community through the provision of educational and promotional material.	DSE, PV, GBCMA	Higher
8.3	Liaise with local community groups and landowners and involve them in the relevant aspects of planning and managing the Barmah Forest Ramsar site.	DSE, PV, Shire, GBCMA	Higher
8.4	Identify opportunities and encourage community involvement in ecological monitoring activities.	DSE, PV	Lower

Management Objective 9

Ensure recreational use is consistent with the protection of natural and cultural values

	Site Management Strategy	Lead agency	Priority
9.1	In consultation with the Yorta Yorta, identify, protect and manage, where appropriate, sites of Aboriginal archaeological and historical interest and significance. Ensure this is done in accordance with Commonwealth and State legislation and in consultation with Aboriginal communities appointed under the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* and Aboriginal Affairs Victoria.	DSE, PV	Higher
9.2	Provide an appropriate enforcement and monitoring presence during duck season.	DSE, PV	Higher
9.3	Manage non Aboriginal historic sites in accordance with the Mid-Murray Forest Management Plan and Barmah State Park and Forest Plan in consultation with local historical societies where appropriate.	DSE, PV	Medium
9.4	Manage camping to ensure that it is environmentally sustainable and minimises degradation to the Murray River environs and also to Aboriginal cultural values as outlined in the Mid-Murray Forest Management Plan and Barmah State Park and Forest Plan.	PV, DSE	Medium
9.5	Monitor the use of the waterways throughout the forest by recreational fishers and enforce regulations to control illegal fishing practices.	DPI	Medium
9.6	Encourage visitors to bring their own firewood to campsites or use alternative heat sources.	DSE, PV	Medium
9.7	Maintain and develop appropriate visitor facilities, including interpretation signs, consistent with the protection of natural and cultural values as outlined in the Mid-Murray Forest Management Plan and Barmah State Park and Forest Plan.	PV, DSE	Medium
9.8	Encourage visitors to practice minimal impact techniques and to adhere to recreational codes of conduct.	PV, DSE	Lower
9.9	Manage visitor and management access according to the Mid-Murray Forest Management Plan and Park Management Plan.	DSE, PV	Lower

Management Objective 10

Develop ongoing consistent programs to monitor ecological character

	Site Management Strategy	Lead agency	Priority
10.1	Seek funding to develop an ongoing consistent program to monitor the ecological character of the Barmah Forest Ramsar site, measured in a statistically sound way and maintain data in appropriate databases. Factors such as water regime, salinity, nutrients, algae, macroinvertebrates, flora and fauna should be measured.	DSE, PV	Higher
10.2	Encourage and seek funding to monitor the effectiveness of rehabilitation, revegetation and habitat protection works in conjunction with similar works in NSW forest areas. Coordinate work and compare results through the Barmah-Millewa Forum.	DSE, PV	Higher
10.3	Continue to record fauna species usage of the Barmah Forest Ramsar site and provide data to update relevant Victorian databases.	DSE, PV	Higher
10.4	Liaise with the Yorta Yorta regarding monitoring of management impacts on cultural heritage values.	DSE, PV	Medium

Lead Agency Key

DSE	Department of Sustainability and Environment	GBCMA	Goulburn Broken Catchment Management Authority
DPI	Department of Primary Industries	GMW	Goulburn-Murray Water
EPA	Environment Protection Authority	PV	Parks Victoria
		Shire	Shire of Moira

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Public Submissions

Australasian Wader Studies Group

Barmah Forest Preservation League

Birds Australia

Bird Observers Club of Australia

Coalition Against Duck Shooting

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Murray-Darling Basin Commission (2000) *Barmah-Millewa Forest Water Management Strategy.* Murray-Darling Basin Commission, Canberra, ACT.

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Ward, K. A., Leitch, C., Lloyd & Atkins, B. P. (1994) *Interim Water Management Strategy for Barmah Forest, Victoria*. Department of Conservation & Natural Resources, Victoria.

Contacts for further information and collaboration

- Barmah Forest Preservation League
- Barmah Millewa Forum
- Bird Observers Club of Australia (Echuca Branch)
- Birds Australia
- Broken Creek Field Naturalists
- Campaspe Shire Council
- Central Highlands Waterwatch c/o Creswick Landcare Centre
- Echuca Moama Field and Game Association
- Environment Australia
- Field and Game Australia
- Goulburn Broken Catchment Management Authority
- Goulburn Broken Waterwatch
- Goulburn Broken Waterwatch - Goulburn Valley Water
- Goulburn Murray Landcare Network
- Goulburn-Murray Water
- Goulburn Valley Environment Group
- Greater Bendigo City Council
- Greening Australia
- Moira Shire Council
- Shepparton Irrigation Region Waterwatch c/o Goulburn Murray Landcare Network
- Superb Parrot Group
- Swan Hill Rural City Council
- Trust for Nature - North Central and Goulburn Broken
- Victorian National Parks Association
- Yorta Yorta Goulburn Murray Rivers Clans Inc.

Related Websites

www.ramsar.org

www.parkweb.vic.gov.au

www.dse.vic.gov.au

www.ea.gov.au

www.gbcma.vic.gov.au

Appendix 3 Threatened Status of Flora

Common Name	Scientific Name	FFG Listed	Status in Victoria	Status in Australia
Austral Trefoil	*Lotus australis*		k	
Bluish Raspwort	*Haloragis glauca f. glauca*		k	
Buloke	*Allocasuarina luehmannii*	L		
Buloke Mistletoe	*Amyema linophylla ssp. orientale*		v	
Button Rush	*Lipocarpha microcephala*		v	
Common Joyweed	*Alternanthera nodiflora*		k	
Corkscrew Spear-grass	*Austrostipa setacea*		r	
Downs Nutgrass	*Cyperus bifax*		v	
Dwarf Bitter-cress	*Rorippa eustylis*		r	
Dwarf Brooklime	*Gratiola pumilo*		r	K
Fat Spectacles	*Menkea crassa*	L	e	
Forde Poa	*Poa fordeana*		k	
Hypsela	*Hypsela tridens*		k	
Leafy Templetonia	*Templetonia stenophylla*		r	
Matted Water-starwort	*Callitriche sonderi*		k	
Mountain Swainson-pea	*Swainsona recta*	L	e	E
Mueller Daisy	*Brachyscome muelleroides*	L	e	V
Narrow-leaf Sida	*Sida trichopoda*		r	
River Swamp Wallaby-grass	*Amphibromus fluitans*		k	V
Silky Browntop	*Eulalia aurea*		r	
Slender Bitter-cress	*Cardamine tenuifolia*		k	
Slender Sunray	*Rhodanthe stricta*	L	e	
Slender Tick-trefoil	*Desmodium varians*		k	
Small Scurf-pea	*Cullen parvum*	L	e	E
Smooth Minuria	*Minuria integerrima*		r	
Summer Fringe-sedge	*Fimbristylis aestivalis*		k	
Twiggy Sida	*Sida intricata*		v	
Umbrella Wattle	*Acacia oswaldii*		v	
Violet Swainson-pea	*Swainsona adenophylla*		e	
Woolly Buttons	*Leiocarpa panaetioides*		r	
Yelka	*Cyperus victoriensis*		k	
Yellow-tongue Daisy	*Brachyscome chrysoglossa*	L	v	

Source: Victorian Flora Information System DSE (2003b)

FFG Listed

L Listed under the *Flora and Fauna Guarantee Act 1988*

A An action statement has been prepared for the management of this species.

Status in Victoria

e Endangered in Victoria, ie. rare and at risk of disappearing from the wild state if present land use and other causal factors continue.

v Vulnerable in Victoria, ie. rare, not presently endangered but likely to become so soon due to continued depletion, or which largely occur on sites likely to experience changes in land use which threaten the survival of the species.

r Plants which are rare in Victoria but which are not considered otherwise threatened. This category indicates relatively few known stands.

k species poorly known, suspected of being in one of the above categories.

Status in Australia under the EPBC Act 1999

CE A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.

E A native species is eligible to be included in the endangered category at a particular time if, at that time:
(a)it is not critically endangered; and
(b)it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

V A native species is eligible to be included in the vulnerable category at a particular time if, at that time:
(a)it is not critically endangered or endangered; and
(b)it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Appendix 4 Threatened Status of Fauna

Common name	Scientific name	FFG Listed	Status in Victoria	Status in Australia
Mammals				
Brush-tailed Phascogale	*Phascogale tapoatafa*	L, A	Vul	
Large-footed Myotis	*Myotis macropus*		LR	
Squirrel Glider	*Petaurus norfolcensis*	L, A	End	
Birds				
Australasian Bittern	*Botaurus poiciloptilus*	L	End	
Australasian Shoveler	*Anas rhynchotis*		Vul	
Azure Kingfisher	*Alcedo azurea*		LR	
Barking Owl	*Ninox connivens*	L, A	End	
Black-chinned Honeyeater	*Melithreptus gularis*		LR	
Blue-billed Duck	*Oxyura australis*	L, A	End	
Brolga	*Grus rubicunda*	L	Vul	
Brown Quail	*Coturnix ypsilophora*		LR	
Brown Treecreeper	*Climacteris picumnus*		LR	
Diamond Dove	*Geopelia cuneata*		LR	
Diamond Firetail	*Stagonopleura guttata*	L	Vul	
Glossy Ibis	*Plegadis falcinellus*		LR	
Great Egret	*Ardea alba*	L	Vul	
Grey-crowned Babbler	*Pomatostomus temporalis*	L, A	End	
Hardhead	*Aythya australis*		Vul	
Hooded Robin	*Melanodryas cucullata*	L	LR	
Intermediate Egret	*Ardea intermedia*	L	CEn	
Latham's Snipe	*Gallinago hardwickii*		LR	
Little Bittern	*Ixobrychus minutus*	L	End	
Little Egret	*Egretta garzetta*	L	End	
Masked Owl	*Tyto novaehollandiae*	L	End	
Musk Duck	*Biziura lobata*		Vul	
Nankeen Night Heron	*Nycticorax caledonicus*		LR	
Painted Honeyeater	*Grantiella picta*	L	Vul	
Pied Cormorant	*Phalacrocorax varius*		LR	
Royal Spoonbill	*Platalea regia*		Vul	
Spotted Harrier	*Circus assimilis*		LR	
Superb Parrot	*Polytelis swainsonii*	L, A	End	V
Whiskered Tern	*Chlidonias hybridus*		LR	
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	L, A	Vul	
Reptiles				
Bandy Bandy	*Vermicella annulata*	L	LR	
Carpet Python	*Morelia spilota metcalfei*	L	End	
Eastern Bearded Dragon	*Pogona barbata*		DD	
Tree Goanna	*Varanus varius*		Vul	

Common name	Scientific name	FFG Listed	Status in Victoria	Status in Australia
Amphibians				
Barking Marsh Frog	*Limnodynastes fletcheri*		DD	
Bibron's Toadlet	*Pseudophryne bibronii*		End	
Fish				
Bluenose (Trout) Cod	*Maccullochella macquariensis*	L, L#, A	CEn	E
Crimson-spotted Rainbowfish	*Melanotaenia fluviatilis*	L, L#	DD	
Flat-headed Galaxias*	*Galaxias rostratus*	L#	DD	
Freshwater Catfish	*Tandanus tandanus*	L, L#	End	
Golden Perch	*Macquaria ambigua*	L#	Vul	
Macquarie Perch	*Macquaria australasica*	L, L#	End	CE
Murray Cod	*Maccullochella peelii peelii*	L, L#	End	
River Blackfish	*Gadopsis marmoratus*		DD	
Silver Perch	*Bidyanus bidyanus*	L, L#	CEn	
Invertebrates				
Murray Spiny Cray**	*Euastacus armatus*	L	DD	

Source: Atlas of Victorian Wildlife DSE (2003a), * Loyn et al. (2002) and ** DPI record.

FFG Listed

L Listed under the *Flora and Fauna Guarantee Act 1988*.

L# Listed under the *Flora and Fauna Guarantee Act 1988* as part of the Lowland Riverine Fish Community of the Southern Murray-Darling Basin.

A An action statement has been prepared for the management of this species.

Status in Victoria

CEn Critically Endangered: A taxon that is facing an extremely high risk of extinction in the wild in the immediate future.

End Endangered: A taxon that is not Critically Endangered but is facing a very high risk of extinction in the wild in the immediate future.

Vul Vulnerable: A taxon that is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

LR Lower Risk – near threatened: A taxon that has been evaluated, does not satisfy the criteria for any of the threatened categories, but which is close to qualifying for Vulnerable. In practice, these species are most likely to move into a threatened category should current declines continue or catastrophes befall the species.

DD Data Deficient - A taxon where there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution or population status. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future investigation will show that a threatened classification is appropriate. Status in Australia under the EPBC Act 1999

Status in Australia under the EPBC Act 1999

CE A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.

E A native species is eligible to be included in the endangered category at a particular time if, at that time:
(a)it is not critically endangered; and
(b)it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

V A native species is eligible to be included in the vulnerable category at a particular time if, at that time:
(a)it is not critically endangered or endangered; and
(b)it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Appendix 5 JAMBA, CAMBA and Bonn Species

Common name	Scientific name	JAMBA	CAMBA	Bonn
Australasian Shoveler	*Anas rhynchotis*			✓
Australian Hobby	*Falco longipennis*			✓
Australian Shelduck	*Tadorna tadornoides*			✓
Banded Lapwing	*Vanellus tricolor*			✓
Black Swan	*Cygnus atratus*			✓
Black-shouldered Kite	*Elanus axillaris*			✓
Brolga	*Grus rubicunda*			✓
Brown Falcon	*Falco berigora*			✓
Brown Goshawk	*Accipiter fasciatus*			✓
Chestnut Teal	*Anas castanea*			✓
Collared Sparrowhawk	*Accipiter cirrhocephalus*			✓
Common Greenshank	*Tringa nebularia*	✓	✓	✓
Glossy Ibis	*Plegadis falcinellus*		✓	
Great Egret	*Ardea alba*	✓	✓	
Hardhead	*Aythya australis*			✓
Latham's Snipe	*Gallinago hardwickii*	✓	✓	
Little Eagle	*Hieraaetus morphnoides*			✓
Masked Lapwing	*Vanellus miles*			✓
Musk Duck	*Biziura lobata*			✓
Pacific Black Duck	*Anas superciliosa*			✓
Peregrine Falcon	*Falco peregrinus*			✓
Pink-eared Duck	*Malacorhynchus membranaceus*			✓
Red-kneed Dotterel	*Erythrogonys cinctus*			✓
Spotted Harrier	*Circus assimilis*			✓
Swamp Harrier	*Circus approximans*			✓
Whistling Kite	*Haliastur sphenurus*			✓
White-bellied Sea-eagle	*Haliaeetus leucogaster*		✓	
White-throated Needletail	*Hirundapus caudacutus*		✓	

Source: Atlas of Victorian Wildlife DSE (2003a)

Appendix 6 Key stakeholders represented on the Murray-Darling Basin Commission Barmah-Millewa Forum

Organisation	State
Arthur Rylah Institute	Vic
Barmah Cattlemens Association	Vic
Barmah Forest Preservation League	Vic
Berriquin Land and Water Management Committee	NSW
Bird Observers Club of Australia	Vic
Department of Infrastructure, Planning and Natural Resources	NSW
Department of Sustainability and Environment	Vic
Echuca-Moama and District Tourism	NSW
Environment Australia	Cwth
Goulburn Broken Catchment Management Authority	Vic
Goulburn-Murray Water	Vic
Mid-Murray Diverters Water Services Committee	Vic
Murray-Darling Association	Vic
Murray-Darling Basin Commission	-
Murray Valley Water Diverters Advisory Association	NSW
Parks Victoria	Vic
Rumbalara Aboriginal Cooperative	Vic
SA Department of Water, Land and Biodiversity Conservation	SA
Shepparton Irrigation Region Implementation Committee	Vic
Shire of Moira	Vic
Shire of Murray	NSW
Southern Riverina Field Naturalists	NSW
State Forests of NSW	NSW
Timber Communities Australia	Vic
Yorta Yorta Nations	NSW

Appendix 7 Barmah Forest Ramsar Information Sheet[1]

Information Sheet on Ramsar Wetlands

Categories approved by Recommendation 4.7 of the Conference of the Contracting Parties.

1. Date this sheet was completed/updated:

May 1999

2. Country:

Australia

3. Name of wetland:

Barmah Forest, Victoria

4. Geographical coordinates:

Latitude: (approx) 35°50' to 36°01'S ;
Longitude: (approx) 144°56' to 145°20'E

5. Altitude:

Approx 90 metres

6. Area:

28,515 hectares

Note: This is a revised area figure based on GIS Mapping (1995) and does not represent any change to the Ramsar Site boundary.

7. Overview:

The Barmah Forest consists of the section of the Murray River floodplain within Victoria (i.e.. south of the main river channel) between the downstream end of the Ulupna Island and Barmah Township. The area includes the Barmah State Park, which was proclaimed in 1987, and the Barmah State Forest. It is an area of River Red Gum *Eucalyptus camaldulensis* forest, subject to periodic inundation. The forest features a variety of permanent and temporary wetlands, including lakes, swamps, lagoons and flooded forest. These wetlands provide habitat for a large number of bird species.

8. Wetland Type:

Inland: N, O, Ts, and Xf

9. Ramsar Criteria:

1a, 2b, 3a, 3b and 3c

10. Map of site included?

Please tick yes ✓ -or- no □

11. Name and address of the compiler of this form:

Parks Victoria
378 Cotham Road
Kew VIC 3101 Australia

12. Justification of the criteria selected under point 9, on previous page.

1(a) The wetland is a particularly good representative example of a natural or near-natural wetland characteristic of the appropriate biogeographic region.

The Barmah-Millewa forest is a good example of, and the largest, River Red Gum (*Eucalyptus camaldulenis*) forest in the state (CFL 1990).

2(b) A wetland is of special value maintaining the generic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna.

Barmah is of special value for maintaining the genetic and ecological diversity of the region because of its size, variety of communities and its high productivity. Barmah Forest also has the most extensive areas of Moira grasslands in Victoria (CFL 1990).

3(a) Regularly supports 20,000 waterfowl

After flood periods, Barmah Forest is one of Victoria's largest waterfowl breeding areas, supporting ducks (particularly Black Duck and Maned Duck), Great Cormorants, Little Black Cormorants, Little Pied Cormorants, White-Faced Herons, Pacific Herons and Rufous Night Herons, Yellow-billed Spoonbills, crakes and rails (EA 2001).

3(b) Regularly supports substantial numbers of waterfowl from particular groups

The forest is an important breeding area for ibis in some years, up to 100,000 nested in the Barmah Area during the 1973-75 flood.

3(c) Regularly supports 1% on the individuals in a population of one species or subspecies

During 1979-80, 1000 Sacred Ibis (3.0% of the State population) and 1700 Straw-necked Ibis (2.2% of the State population) nested in Barmah Forest. Higher numbers have occurred in some years (i.e.. an estimated 100,000 ibis nested in the Barmah area during the 1973-75 flood).

[1] Ramsar Information Sheets are updated every six years. The last update was in 1999. New or revised information will be incorporated in the next update, due in 2005.

13. General location:

Murray River, Victoria, Australia.

14. Physical features:

The Forest, particularly the western section, contains all the characteristic geomorphological elements of the Riverine Plains including the prior streams, lakes, lunettes, ancestral rivers, source-bordering dunes, and deltaic features. Erosional and depositional fluvial, lacustrine and aeolian processes are evident. Many ancestral geomorphic features are relatively well preserved.

The soils of the forest consist of a mottled clay subsoil and a bleached hard-setting topsoil. The predominant light grey clays often contain patches of reddish-yellow ferric oxide, indicative of regular waterlogging. In places the clay layers overly sand drifts, which can also form a sandy loam on higher ridges within the forest.

Natural waterways in the forest are all anabranches of the Murray River. A section of the river known as the Barmah Choke has a relatively low capacity, so water flowing down this channel spills over, via a series of effluent creeks into the forest and wetlands. Under natural conditions Barmah Forest was extensively flooded in winter/spring of most years. It has been estimated that 70% of the forest was flooded for an average of 2.9 months in 78% of years. Since regulation of Murray River flows, this level of flooding is only experienced for an average of 1.3 months in 37% of years.

The majority of Barmah Forest functions as a single floodplain wetland system dependent on regular river flooding. Component wetlands vary considerably in their seasonality, characteristics and size. Wetlands range from permanent lakes, billabongs and ponding effluents; through shallow basins with prolonged seasonal flooding which support rushland (*Juncus ingens*) or grassland (Moira Grass - *Pseudoraphis spinescens*) communities; to a gradational series of River Red Gum forest/woodland communities with wetland understories determined largely by flooding frequency and duration. Box woodland communities are above the normal high flood level.

15. Hydrological values:

Barmah Forest forms a natural flood retardation basin with an estimated holding capacity of 32100 ML.

16. Ecological features:

Adjoining the Barmah Forest is the Millewa group of forests in New South Wales, and together they form the largest River Red Gum (*Eucalyptus camaldulensis*) forest in Australia. Seasonal inundation of the Red Gum forest by the River Murray is an ecological requirement for regeneration of this forest and maintenance of its biota. Considerable modification of natural flooding cycles has occurred during the past five decades, influencing the health of this wetland. Barmah Forest features Red Gum, Grey Box (*Eucalyptus microcarpa*), Yellow Box (*Eucalyptus melliodora*) and Black Box (*E. largiflorens*) woodlands, grasslands and various wetland vegetation.

The forest is an important breeding area for ibis in some years. During 1979-80, 1000 Sacred Ibis (3.0% of the State population) and 1700 Straw-necked Ibis (2.2% of the State population) nested here. Higher proportions are likely in some years (i.e.. an estimated 100,000 ibis nested in the Barmah area during the 1973-75 flood). Other colonially nesting species (e.g. cormorants, egrets, spoonbills also nest in years of flood.

17. Noteworthy flora:

556 species of vascular plants have been recorded in Barmah Forest. Of these, 354 are indigenous and 202 are exotic. Around one third of these species are found only within Box woodland areas.

Threatened Species

- *Acacia osswaldii* (Umbrella Wattle) depleted
- *Allocasuarina luehmannii* (Buloke) depleted
- *Amphibromus fluitans* (River Swamo Wallby-grass) vulnerable
- *Amyema linophyllum* (Buloke Mistletoe) vulnerable
- *Austrostipa setacea* (Corkscrew Spear-grass) rare
- *Brachyscome chrysoglossa* (Yellow-tongue Daisy) vulnerable
- *Brachyscome muelleroides* (Mueller Daisy) endangered
- *Brachyscome readeri* (Reader's Daisy) rare
- *Cardamine tenuifolia* (Slender Bitter-cres) insufficiently known
- *Cullen parvum* (Small Scurf-pea) endangered
- *Cymbonotus lawsonianus* (Bear's Ears) rare
- *Cypres eragrostis* (Downs Flat-sedge) vulnerable
- *Cyperus flaccidus* (Flaccid Flat-sedge) vulnerable
- *Danthonia procera* (Tall Wallaby-grass) insufficiently known
- *Desmodium varians* (Slender Tick-trefoil) rare
- *Digitaria ammophila* (Silky Umbrella Grass) vulnerable

- *Eleocharis minuta* (Variable Spike-sedge) endangered
- *Eragrostis tenellula* (Delicate Love-grass) rare
- *Fimbristylis velata* (Veiled Fringe-sedge) rare
- *Gratiola pumilo* (Dwarf Brooklime) insufficiently known
- *Haloragis glauca forma glauva* (Bluish Raspowort) vulnerable
- *Helipterum strictum* (Upright Sunray) endangered
- *Hypsela tridens* (Hypsela) vulnerable
- *Leptorhynchos panaetioides* (Woolly Buttons) rare
- *Lipocarpha microcephala* (Button Rush) vulnerable
- *Lotus cruentus* (Red Bird's-foot Trefoil) depleted
- *Maireana microphylla* (Small-leaf Bluebush) vulnerable
- *Menkea crassa* (Fairy Spectables) endangered
- *Minuria integerrima* (Smooth Minuria) rare
- *Myoporum acuminatum* (Waterbush) rare
- *Psoralea parva* (Small Psoralea) endangered in Australia,endangered in Victoria
- *Rhodenthe stricta* (Slender Sunray) endandered
- *Swainsona microcalyx* (Violet Swainson-pea) Poorly known in Australia, vulnerable in Victoria
- *Templetonia stenophylla* (Leafy Templetonia) depleted

18. Noteworthy fauna:

31 species have been recorded, including 7 exotic species and 12 bat species. At least 5 additional species were formerly present.

Threatened Species

- Squirrel Glider (*Petaurus norfolcensis*) rare
- Tuan (*Phascogale tapoatafa*) rare
- Large-footed Myotis (*Myotis adversus*) indeterminate

REPTILES

16 species have been recorded. An additional 2 species are possible.

Threatened Species

- Hooded Scaly-foot (*Pygopus nigriceps*) rare
- Curl Snake (*Suta suta*) rare
- Bandy Bandy (*Vermicella annulata*) vulnerable
- Carpet Python (*Morelia spilota variegata*) vulnerable

AMPHIBIANS

8 species have been recorded.

Threatened Species

- Long-thumbed Frog (*Limnodynastes fletcheri*) insufficiently known

FISH

21 species are likely to occur in Barmah Forest, including 6 exotic species.

Threatened Species

- Blue-nosed Cod (*Maccullochella macquariensis*) endangered
- Murray Cod (*Maccullochella peeli*) vulnerable
- Silver Perch (*Bidyanis bidyanis*) vulnerable
- Macquarie Perch (*Macquaria australasica*) vulnerable
- Golden Perch (*Macquaria ambigua*) rare
- Blackfish (*Gadopsis marmoratus*) indeterminate
- Freshwater Hardyhead (*Craterocephalus stercusmuscarum*) indeterminate
- Flat-headed Galaxias (*Galaxias rostratus*) indeterminate
- Bony Bream (*Nematolosa erebi*) rare
- Crimson-spotted Rainbow Fish (*Melanotaenia fluviatilis*) rare
- Freshwater Catfish (*Tandanus tandanus*) vulnerable

19. Social and cultural values:

A large number (hundreds) of aboriginal sites within Barmah have only been partially surveyed and registered. These sites include burial grounds, mounds, middens, and scarred trees. Barmah Forest was one of the more densely populated areas of Australia prior to European settlement. The descendants of the local tribes maintained close links with the Barmah Forest through the nearby Cummeragunja reserve in N.S.W. and through intermittent settlement in the Forest. The present day descendants refer to themselves as the Yorta Yorta, and have a close involvement with planning, management and interpretation at Barmah.

Barmah has a rich and colourful history of European settlement although few relics or artefacts remain. Place names dating from early grazing and logging days provide the most accessible link. Remaining relics of the European heritage include:

- an old sawmill boiler

- old wooden fences

- canal cuttings

- stumps with springboard holes

20. Land tenure/ownership:

In 1987, 7900 hectares of the Barmah Forest were proclaimed as Barmah State Park. There are also two Reference Areas covering 280 hectares. The remaining area is classified as State Forest.

21. Current land use:

The Land Conservation Council (1985) defined the major functions of each land-use category as follows:

State Park:

- to provide opportunities for recreation and education associated with the enjoyment and understanding of natural environments;
- to conserve and protect natural ecosystems; and
- to act as part of the river regulation and flood mitigation system of the Murray River.

Reference Areas:

- to maintain natural ecosystems as a reference to which those concerned with studying land for particular comparative purposes may be permitted to refer, especially when attempting to solve problems arising from the use of land; and
- to prohibit activities (such as grazing, exploration for minerals and gold, mining, logging, and beekeeping) that conflict with the purposes of a reference area).

State Forest:

- to produce hardwood timber;
- to conserve native plants and animals, and provide opportunities for the development of wildlife conservation techniques;
- to provide for open-space recreation and education;
- to provide for flood mitigation;
- to produce honey, forage, sand and other forest produce such as charcoal; and
- to protect values in identified nature conservation and historic sites by implementation of management prescriptions.

22. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects:

Long term changes in ecological character in Barmah Forest are primarily attributed to changed water regimes, timber harvesting and cattle grazing. Further ecological change has not generally been significant since listing in 1982.

The forest has evolved on land which, under natural conditions, is flooded in the spring months of most years but are rarely flooded in the summer months. Since construction of upstream water storages such as Lake Hume in 1934 and Lake Dartmouth in 1980, spring flooding has decreased and summer flooding increased. Thus the amount and timing of water flowing into the forest has been changed.

Factors affecting the ecological character of selected areas within the site:

- altered hydrological conditions within wetlands;
- rising saline groundwater levels;
- drainage water inflow;
- stock grazing; and
- timber harvesting.

23. Conservation measures taken:

Reservation of part of the forest as a State Park and of some areas as References Areas provide for the protection of natural values;

The Barmah State Park and Barmah State Forest Management Plan (1992) outlines strategies to manage the Forest and protect environmental values.

The Interim Water Management Strategy for the Barmah Forest 1993 formulated hydrological management options for Barmah Forest.

Action Statements under the Flora and Fauna Guarantee Act 1988 have been produced for the following fauna species that occur in the Ramsar site. They outline conservation measures for the species.

- Small Psoralea (1991)
- Superb Parrot (1992)
- White-bellied Sea-eagle (1994)
- Grey-crowned Babbler (1995)
- Regent Honeyeater (1994)

24. Conservation measures proposed but not yet implemented:

The proposed Mid Murray Forest Management Plan is close to finalisation. The plan includes strategies for ecologically sustainable management of timber production, grazing, recreation and other uses of the part of the site that is State Forest.

In 1993, an annual 100 GL environmental water allocation was made for Barmah Forest and the adjoining Millewa Forest in New South Wales. An environmental water entitlement is close to finalisation with an additional 50 GL annual entitlement sought for Barmah/Millewa and negotiations proceeding with New South Wales to allow the allocation to be accumulated for more than one year, allowing more flexibility in managing the watering regime.

A business plan for water management in the Barmah Millewa Forest is due to be finalised by the end of 1998. The plan will outline strategies for management of the environmental water entitlement.

In an integrated approach to planning at Ramsar sites, management strategies are being prepared for all Ramsar sites in Victoria, including Barmah Forest, to provide general strategic direction and site specific strategies. The strategies will be completed by June 1999.

25. Current scientific research and facilities:

A number of studies have been, or are being, undertaken, particularly in the fields of forest ecology, floodplain ecology and hydrology.

Barmah probably provides one of the best examples in Australia for studies within an extensive River Red Gum floodplain forest system.

Investigations of Superb Parrot numbers and breeding areas.

26. Current conservation education:

The Dharnya Centre within Barmah Forest includes a visitor centre with an information display on aspects of fauna, flora, hydrology and heritage. A number of interpretative leaflets and other publications are available.

The Dharnya Centre has bunkhouse accommodation for up to 56 people and a kitchen/dining area. These facilities are used by university, school and other groups. A part-time teacher is available to assist with education and interpretation. Aboriginal rangers are available to assist with interpretation of natural history and aboriginal culture.

27. Current recreation and tourism:

An estimated 100,000 visitor days were spent in Barmah Forest during 1988. Visitation is highly seasonal, concentrated during the warmer months and particularly over Christmas and Easter. Access during winter and spring can be difficult due to flooding.

Recreational activities focus on the Murray River frontage, with some spread across the whole Forest. Recreational opportunities from semi-remote to semi-developed are available. Barmah provides the best semi-remote opportunities within an extensive agricultural region. In he Barmah State Park and Barmah State Forest Management Plan (1992), Dharnya/The Gap, The Gulf, and Morgan's Beach have been zoned for intensive recreation.

Recreational activities engaged in within Barmah include: pleasure driving, 4WD driving, trail bike riding, cycling, horse riding, bushwalking, orienteering, picnicking, camping, canoeing, boating, fishing, duck shooting hunting of feral animals, and nature study.

28. Jurisdiction:

Government of Victoria.

29. Management authority:

Managed under the Department of Natural Resources and Environment Parks Program by Parks Victoria - 8,251 Ha (28%)

Natural Resources and Environment - 21,264 Ha (72%)

30. Bibliographical references:

Department of Conservation, Forests and Lands. (1990). Proposed Barmah Management Plan - Barmah State Park and Barmah State Forest. Benalla Region, National Parks and Wildlife Division and Lands and Forest Division, Department of Conservation, Forests and Lands, Victoria.

Webster, R. (1988). The Superb Parrot: a survey of the breeding distribution and habitat requirements. ANPWS, Canberra.