

# Forrestdale Lake Nature Reserve

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## Management Plan

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### 2005

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Management Plan No. 53



Conservation Commission  
of Western Australia



DEPARTMENT OF  
**Conservation**  
AND LAND MANAGEMENT  
*Conserving the nature of WA*

# FORRESTDALE LAKE NATURE RESERVE

## Management Plan 2005

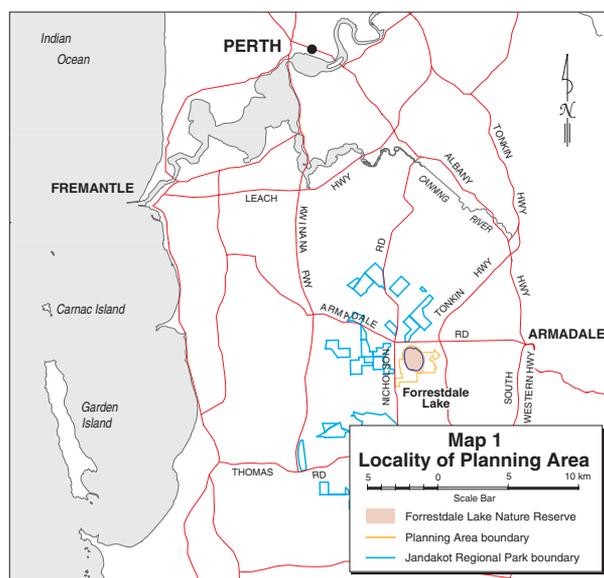
### PART A INTRODUCTION

#### BRIEF OVERVIEW

Forrestdale Lake Nature Reserve (Forrestdale Lake) is a Class A reserve of 245 ha, gazetted for the Conservation of Flora and Fauna. It is located approximately 25 km south-east of Perth, in the City of Armadale (Map 1).

Situated on the Swan Coastal Plain in the Swan Coastal Plain bioregion, the reserve is one of the most important conservation areas in southwestern Australia (CALM 1987). It is internationally important as a habitat and refuge for water birds, and in 1990, together with Thomsons Lake, was designated to the List of Wetlands of International Importance under the Convention on Wetlands (Ramsar, Iran, 1971). Together they comprise Ramsar site number 481.

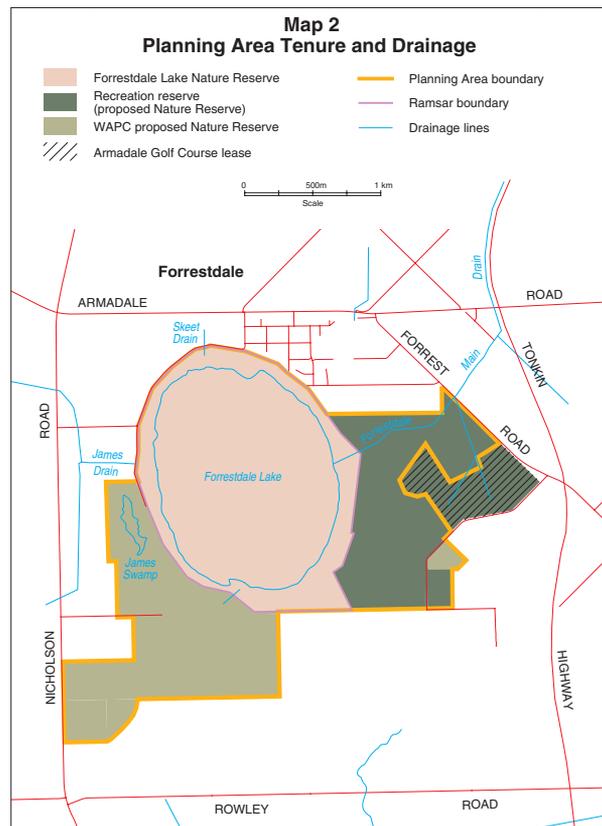
It is also included in the *Directory of Important Wetlands in Australia* (Environment Australia 2001), and, due to the significance of Forrestdale Lake for flora and fauna conservation and recreation, it was added to the Register of the National Estate<sup>1</sup> in March 1978. Furthermore, Forrestdale Lake is a Conservation Category Wetland, which is the highest priority for wetland conservation, and has been given protection under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*, a revised draft of which (the *revised draft Environmental Protection (Swan Coastal Plain Wetlands) Policy 2004*) was being developed at the time of writing this management plan.



## PLANNING AREA

This management plan also incorporates the adjoining Recreation Reserve number 27165, excluding the current golf course lease, and adjacent land that is owned by the Western Australian Planning Commission (WAPC), which in total, comprise 256 ha. The Bush Forever report (State of Western Australia 2000) recommends that this WAPC land be added to the Nature Reserve (Map 2), a proposal that has been addressed in this management plan.

Therefore, throughout the plan any reference to Forrestdale Lake Nature Reserve should be read as including Reserve No. 27165 and the adjoining WAPC land, as shown in Map 2. The planning area (i.e. the existing nature reserve and proposed additions) comprises 501 ha in total.



<sup>1</sup> The Register of the National Estate is Australia's national inventory of natural and cultural heritage places which are worth keeping for the future. It is compiled by the Australian Heritage Council—the Commonwealth Government's adviser on the National Estate and heritage matters.

## KEY VALUES OF THE PLANNING AREA

Maintaining or enhancing the key values of the planning area is the major focus of this management plan. The objectives and strategies in the plan are targeted to ensure this is achieved (management summary table). How these values relate to the auditing of the management plan is detailed in *Performance Assessment*.

The outstanding values of the planning area are those that contribute to its Ramsar listing. In its joint listing with Thomsons Lake, Forrestdale Lake satisfies three criteria for nomination to the Ramsar list:

- internationally significant waterbird habitat which regularly supports more than 1% of the individuals of the known Australian population of the long-toed stint<sup>2</sup>;
- it is of special value for maintaining the genetic and ecological diversity of the region because of the qualities and peculiarities of its flora and fauna; and
- it is a particularly good representative of a natural or near-natural wetland, characteristic of those that were once widespread on the Swan Coastal Plain.

(*Environment Australia 2001*)

Other key conservation values are:

- its significance for the protection of rare, threatened and priority flora and fauna, and threatened ecological communities (TECs); and
- plant communities representative of the eastern side of the Swan Coastal Plain.

Forrestdale Lake also has significant cultural values, viz:

- a rich Aboriginal heritage; and
- natural and cultural values close to urban centres that provide opportunities for nature appreciation and education.

## ECOLOGICAL CHARACTER<sup>3</sup>

Forrestdale Lake, together with co-listed Ramsar wetland Thomsons Lake, is the best remaining example of a brackish, seasonal lake with extensive fringing sedgeland typical of the Swan Coastal Plain. In a regional context, the two lakes constitute a major breeding, migration stopover and semi-permanent drought refuge area for waterbirds (CALM 2003a). Forrestdale Lake is a groundwater lake and surface run-off probably had little effect on its depth when it was in an undisturbed condition. The lake contains open water but is fringed by rushes and bulrushes, behind which are belts of trees tolerant of water-logging. The higher ground around the lake supports open woodland and there is a dense mat of *Chara* sp. and *Ruppia polycarpa* in the water. Around the edge there is an almost continuous belt of (introduced) *Typha orientalis*, behind which *Baumea articulata*, *B. juncea*, *Juncus pallidus* and *Cyperus congestus* sometimes grow. Beyond these is a belt of trees,

<sup>2</sup> See Migratory Birds section in Native Animals and Habitats.

<sup>3</sup> Ecological Character is defined in the Ramsar Convention (Resolution VII.10 of the 7<sup>th</sup> meeting of the Conference of the Contracting Parties to the Convention), and under the EPBC Act as "...the sum of the biological, physical and chemical components of the wetland ecosystem, and their interactions, which maintain the wetland and its products, functions and attributes" (Macintosh and Kennedy 2004).

principally *Melaleuca raphiophylla*, but *Acacia saligna* and *Eucalyptus rudis* also occur on the landward side of this zone. The higher sandy ground on the eastern side of Forrestdale Lake supports open woodland dominated by *Banksia attenuata* (CALM 2003a).

Forrestdale Lake provides important habitat for waterbirds on the Swan Coastal Plain with more than 20 000 water birds having been recorded on Forrestdale Lake (22 196 in January 1986). Annual data on water depth indicates that conditions at the lake are suitable for use by more than 20 000 waterbirds at least several times within a 25-year period (which is considered sufficient evidence of regular use by 20 000 waterbirds) (CALM 2003a).

Forrestdale Lake regularly supports more than 1% of the national population of five shorebirds: Red-capped Plover (*Charadrius ruficapillus*) (up to 1300); Black-winged Stilt (*Himantopus himantopus*) (3840); Red-necked Avocet (*Recurvirostra novaehollandiae*) (1113); Long-toed Stint (*Calidris subminata*) (up to 80); and Curlew Sandpiper (*Calidris ferruginea*) (2000, January 1983) (CALM 2003a).

Seventy species of waterbird occur at both Forrestdale and Thomsons Lakes with 21 of them breeding. Although waterbirds are the main feature of both Forrestdale and Thomsons Lakes, they also represent some of the best surviving examples of the once numerous wetlands on the Swan Coastal Plain and as such are geologically and botanically interesting. In addition, the margins of the lake support a large number of terrestrial birds and other vertebrate species (see *Native Animals and Habitats*).

## LAND TENURE

Forrestdale Lake is a Class A Nature Reserve (number 24781), gazetted in 1957 for the Conservation of Flora and Fauna. It is vested with the Conservation Commission of WA (Conservation Commission) and managed by the Department of Conservation and Land Management (CALM or the Department). The adjoining reserve (number 27165) is vested in the City of Armadale for the purpose of Recreation, and is reserved for 'Parks and Recreation' in the Metropolitan Region Scheme (MRS). It contains Declared Rare Flora (DRF) and Priority flora species, and two TECs.

This management plan proposes that the vesting of the recreation reserve, excluding the golf course, be transferred to the Conservation Commission and that it be managed by CALM as nature reserve. Negotiations to this effect are underway between the Department and the City of Armadale. It is proposed that upon release of this management plan, CALM will begin managing the portion of the reserve outside the existing golf course lease, consistent with the management of the nature reserve (Map 2).

CALM will continue negotiations with the City of Armadale regarding the transfer and management of part or all of the land occupied by the nine-hole golf course once the City's new course is developed and the Forrestdale course is no longer required. Any portion of the golf course managed by CALM will be rehabilitated in the long term and managed for conservation purposes as part of the nature reserve.

The WAPC, through the Department for Planning and Infrastructure (DPI), has been acquiring land under the MRS consistent with the Bush Forever recommendations, with the intention of adding them to the nature reserve (Map 2). CALM will continue to liaise with DPI and pursue having these lands added to the nature reserve and vested in the Conservation Commission.

There are also four road reserves in the planning area that are currently managed by the City of Armadale, and which are used as bridle trails by horseriders (see Map 2). This management plan proposes that these be closed and that the vesting of them be transferred to the Conservation Commission, for inclusion in the nature reserve and management by CALM (see Land Tenure in the management summary table).

## REGIONAL CONTEXT

Forrestdale Lake Nature Reserve is located on the southern fringes of Perth's metropolitan area. It is one of the few remaining examples of the lakes and vegetation originally found on the Swan Coastal Plain, and is included in the State Government Environmental Protection (Swan Coastal Plain Lakes) Policy (1992) as a wetland having conservation value.

The Statement of Significance for Forrestdale Lake on the Register of the National Estate says that the lake is of regional importance in terms of bird numbers, being in the top 1% of wetlands in the south west of Western Australia for numbers of individual birds of 20 different bird species. It is one of 12 Ramsar sites in Western Australia and one of four in the Swan Coastal Plain bioregion.

Adjacent land-uses at Forrestdale Lake include residential development (Forrestdale township), a primary school and rural-living blocks.

Significant conservation areas, namely the Jandakot Regional Park and the Wungong Brook, lie close to the planning area and are connected by existing vegetation or proposed re-vegetation sites, thus considerably extending regional wildlife corridors and habitat.

The planning area is part of Bush Forever site 345 'Forrestdale Lake and Adjacent Bushland, Forrestdale', which also includes adjoining lands and Conservation Category Wetlands that the Bush Forever report recommends be added to the nature reserve (State of Western Australia 2000). This management plan supports the recommendation (see *Land Tenure*).

### **Integrated planning for Forrestdale Lake Nature Reserve**

Jandakot Regional Park is located to the west of the planning area (Map 1). At the time of writing this plan, a draft management plan for the regional park had been released by CALM for public comment. Given the close proximity of the two planning areas, the management planning processes for Jandakot Regional Park and Forrestdale Lake Nature Reserve and surrounds have been integrated to ensure a coordinated approach to the management of these areas by CALM. The potential for the inclusion of Forrestdale Lake into Jandakot Regional Park will be investigated over the life of the plan, once the proposed additions to Forrestdale Lake have been vested in the Conservation Commission and included in the nature reserve. However,

the inclusion of Forrestdale Lake in the regional park would not represent a change in the level of protection afforded to the nature reserve, nor the management objectives for it. Management of Forrestdale Lake will still be in accordance with this management plan, whether or not it is included in the regional park.

## PART B MANAGEMENT DIRECTIONS AND PURPOSE

### VISION

The vision for Forrestdale Lake Nature Reserve is:

*To be recognised by the community for its international significance as a wetland providing refuge for both migratory waders and local waterbirds, and where natural, cultural (Indigenous and other Australian) and aesthetic values are appreciated and protected. Natural systems and processes will be able to function and evolve, and flora, fauna and habitats will be managed to a high standard in partnership with the community for their intrinsic values, as a refuge for wildlife and as a safe place to be enjoyed by present and future generations.*

### LEGISLATIVE FRAMEWORK

#### Legislation and policies

Nature reserves are created under the *Land Administration Act 1997*, vested in the Conservation Commission, and managed by CALM. The Department has prepared this management plan in accordance with the legislative specifications of the *Conservation and Land Management Act 1984* (CALM Act).

Sections 54-56 of the Act specify that:

- the Conservation Commission is responsible for the preparation of management plans, through the agency of the Department, for all land vested in it;
- a management plan must contain a statement of policies or guidelines to be followed in the management of the area, and a summary of the operations proposed to be taken over the life of the plan;
- a management plan for a nature reserve must... *“Maintain and restore the natural environment and to protect, care for, and promote the study of indigenous flora and fauna, and to preserve any feature of archaeological, historic or scientific interest.”*

Each plan is periodically subject to audit by the Conservation Commission (section 9) and remains in force until such time as a new plan is prepared. The procedure to make an amendment to a gazetted management plan is governed by section 61 of the CALM Act and also involves a public consultation process.

The CALM Act also covers such matters as defining categories of lands and waters managed by CALM, establishing controlling bodies, establishing and defining the functions of CALM and the controlling bodies, management planning and auditing, permits, licences, contracts, leases, offences and enforcement.

CALM is directly responsible for administration of the *Wildlife Conservation Act 1950* (Wildlife Conservation Act) and associated regulations for the conservation and protection of indigenous flora and fauna on all lands and waters within the State.

A number of other Acts affect CALM's activities or confer specific powers on CALM.

***Environment Protection and Biodiversity Conservation Act 1999***

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes a legislative framework that allows the Commonwealth to manage environmental protection through an assessment and approvals process, and biodiversity conservation through species and site listing, recovery and management planning. The ecological values of Ramsar wetlands are a matter of national environmental significance under this Act, as are migratory species listed under the Act, listed threatened species and ecological communities and the national heritage values of National Heritage places (Macintosh and Kennedy 2004).

The presence of migratory birds protected under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA) means that Forrestdale Lake is given additional protection under the EPBC Act. Any action that has had, will have, or is likely to have a significant impact on a matter of national environmental significance such as Ramsar wetlands and migratory species listed under international treaties, such as the Australian agreements with Japan (JAMBA) and China (CAMBA) and the Bonn Convention, is required to undergo an environmental assessment and approvals process.

The EPBC Act also establishes standards for managing Ramsar wetlands through the Australian Ramsar Management Principles, which are stated as Regulations under the Act and which describe the principles and guidelines for the management of Ramsar wetlands (Environment Australia 2001).

***Environmental Protection Act 1986***

The *Environmental Protection Act 1986* provides for the creation of the Environmental Protection Authority, which was established as an independent authority with the broad objective of protecting Western Australia's environment. The Act also provides for the prevention, control and abatement of pollution and environmental harm, and for the conservation, preservation, protection, enhancement and management of the environment. Activities that impact on wetlands, such as filling, draining, mining, discharges or clearing, are prohibited without authorisation under this Act.

***Aboriginal Heritage Act 1972***

All registered sites within Forrestdale Lake Nature Reserve are protected under the *Aboriginal Heritage Act 1972* (Aboriginal Heritage Act). This Act ensures the protection of places and objects customarily used by or traditional to, the original inhabitants of Australia. A register of such places and objects is maintained under the Act, however, all sites are protected under the Act whether they have been entered on the register or not.

#### *Native Title Act 1993*

The (Commonwealth) *Native Title Act 1993* requires that native title claimants and representative bodies be advised when a management plan is being prepared or major public works undertaken on the conservation estate. The South-West Aboriginal Land and Sea Council is the native title representative body for the reserve and has a number of functions prescribed under the Native Title Act.

The following State and Commonwealth policies relate specifically to the management of wetlands:

#### *Wetlands Policy of the Commonwealth Government of Australia 1997*

This policy provides strategies to ensure that the activities of the Commonwealth Government promote the conservation, ecologically sustainable use and, where possible, enhancement of wetland functions. A principle aim is to ensure that the Commonwealth Government's actions are consistent with those expected under the Ramsar Convention and, in particular, to promote the adoption of Ramsar's 'wise use' principles for managing wetlands (ANCA 1997).

#### *Wetlands Conservation Policy for Western Australia 1997*

The *Wetlands Conservation Policy for Western Australia 1997* (Wetlands Conservation Policy) is the result of the Government's recognition of the fundamental importance of conserving and managing wetlands in a sustainable manner. It outlines the Government's commitment to identifying, maintaining and managing the State's wetland resources, including the full range of wetland values, for the long term. It provides broad objectives for wetlands, waterways, estuaries and shallow marine areas, and provides an implementation strategy specifically for the management of wetlands in WA. It also identifies the agencies involved and their responsibilities. Under this policy, a Wetlands Coordinating Committee was established, with representatives from various agencies and community conservation groups, to facilitate interaction between management agencies. This Committee is chaired by CALM and provides a forum for information exchange regarding the management of wetlands within Western Australia.

#### *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*

This policy protects the environmental values of Forrestdale Lake and prohibits any unauthorised filling, mining, draining (into and out of the wetland), effluent discharge and alteration of water levels. The policy provides for the protection of the ecosystem health of wetlands on the Swan Coastal Plain, such as Forrestdale Lake, including the protection of the ecological structure, function and processes of the wetland, as well as the protection of the beneficial uses including its use for study, education, recreation, aesthetic enjoyment and the benefit of the public generally (EPA 2004). The EPP was prepared under the Environmental Protection Act, and, as stated in section 1 of this plan (*Brief Overview*), is currently under revision (the revised draft *Environmental Protection (Swan Coastal Plain Wetlands) Policy 2004*).

#### *CALM policies*

Policies of the Department of CALM that are specifically mentioned in this plan relate to the management of weeds, fire, disease, rehabilitation, recreation and tourism and community involvement. These policies are listed in the References section.

### **Obligations and agreements**

Australia is a participant of, and signatory to, a number of important international conservation agreements that influence the management of Forrestdale Lake, by promoting consistent standards of management for wetlands. In becoming signatory to such agreements, Australia is committed to fulfil certain obligations in managing important wetlands. These include:

#### *The Convention on Wetlands (Ramsar, Iran, 1971)*

The Convention on Wetlands, signed in the Iranian city Ramsar in 1971, (more commonly known as the Ramsar Convention), is an intergovernmental treaty dedicated to the conservation and 'wise use' of wetlands. The Convention's mission is: 'the conservation and wise use of wetlands by national action and international cooperation as a means to achieving sustainable development throughout the world'. It encourages Contracting Parties to designate sites containing representative, rare or unique wetland types, or that are important for conserving biological diversity to the List of Wetlands of International Importance (Ramsar sites). These sites need to be managed to ensure their special ecological values are maintained or improved. Australia became a Contracting Party in 1974.

The criteria under which Forrestdale (and Thomsons) Lakes were originally nominated as a Ramsar Site were:

- 1a it is a particularly good example of a specific type of wetland, characteristic of its region;
- 2b it is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna; and
- 3c where data on populations is available, it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl.

Since that time, the criteria have been further developed and re-numbered by Ramsar Conferences of the Contracting Parties as follows:

- 1 It contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region (the Swan Coastal Plain bioregion);
- 3 It supports populations of a plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region;
- 5 It regularly supports 20 000 or more waterbirds; and
- 6 It regularly supports 1% of the individuals in a population of one species or subspecies of waterbird (long-toed stint).

At the time of writing, these revised criteria were yet to be formally accepted by the Ramsar Convention Secretariat. Once this has occurred, a revised Ramsar sheet for Forrestdale and Thomsons Lake will be available from [www.deh.gov.au/water/wetlands/database/index.html](http://www.deh.gov.au/water/wetlands/database/index.html).

#### *Japan-Australia Migratory Bird Agreement (JAMBA)/China-Australia Migratory Bird Agreement (CAMBA)*

Australia has signed treaties with Japan and China to protect migratory birds. The JAMBA and CAMBA treaties provide for co-operation between the respective governments to protect migratory species and their habitats. Sixty-six bird species are listed under the JAMBA treaty and

88 under CAMBA. Twenty-one of these have been recorded at Forrestdale Lake (Burbidge and Birds Australia WA 2002), where the protection of fringing vegetation and mudflats is a key consideration for management to ensure the maintenance of suitable habitat for these species.

*Convention on the Conservation of Migratory Species of Wild Animals (Bonn, 23 June 1979)*

The aim of the Bonn Convention is to protect listed species across their entire migratory range. Australia has been a Range State<sup>4</sup> under this Convention since 1991 since it entered into force here on 1 September 1991. The Convention obligates contracting parties to take measures for the conservation of migratory species of wild animals listed under the Convention, and for which they are a range state. Migratory species listed under this Convention are a matter of national environmental significance under the EPBC Act's assessment and approval provisions.

## PERFORMANCE ASSESSMENT

### Audit by the Conservation Commission

The Conservation Commission has the responsibility for auditing the implementation of this management plan and will measure overall management performance and the effectiveness of it by assessing the Key Performance Indicators (KPIs) listed in Table 1, and other parameters as appropriate. It is not efficient to measure all aspects of management given resource and technical impediments – consequently, indicators will target ‘key’ components of the plan. Kanowski *et al.* (2001) defined ‘key’ performance indicators, when considering the conservation of biodiversity, as: “*the minimum set, which if properly monitored, provides rigorous data describing the major trends in, and impacts on, Australian biodiversity.*” In the case of this plan, it includes evaluation of a measure and target, reporting requirements and a management response to any target shortfall. These components provide a basis for adaptive management, whereby management is altered if necessary to meet a desired outcome.

CALM is responsible for providing information to the Conservation Commission so it can assess the success of the Department's management in meeting targets specified in the KPIs. The frequency of these reports will depend on the requirements of each KPI, the satisfactory establishment of baseline information against which to audit, and any unforeseen changes to the environmental conditions. Where a report identifies a target shortfall, a response to the Conservation Commission is required. The response may identify factors that have led to the target shortfall, and propose alternative management actions where appropriate. The Conservation Commission will consider CALM's response on the target shortfall and evaluate the need for action in the context of its assessment and audit function under section 19(1)(g)(iii) of the CALM Act. The Commission will make results of such audits available to the public.

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<sup>4</sup> A Range State is defined as any state that exercises jurisdiction over any part of the range of that migratory species, or a state, flag vessels of which are engaged outside national jurisdictional limits in taking that migratory species.

## PART C MANAGING THE NATURAL ENVIRONMENT

### BIOGEOGRAPHY

The National Reserve System Program (NRS) was adopted to preserve Australia's native biodiversity on a regional scale, and initiate a protected reserve system that meets the world's best standards in terms of comprehensiveness, adequacy and representativeness (Thackway and Cresswell 1995). As a framework for developing this reserve system, the NRS initiated the Interim Biogeographic Regionalisation for Australia (IBRA), which provides a framework for conservation planning for a comprehensive, adequate and representative system of protected areas to conserve Australia's terrestrial biodiversity. It divides Australia into 85 bioregions based on dominant landscape characteristics of climate, lithology, geology, landforms and vegetation, and each reflecting a unifying set of major environmental influences which shape the occurrence of flora and fauna and their interaction with the physical environment. Twenty-six bioregions occur in WA.

Forrestdale Lake Nature Reserve is in the Swan Coastal Plain sub region of the Swan Coastal Plain bioregion, a low lying coastal plain, mainly covered with woodlands, which is dominated by banksias or tuart (*Eucalyptus gomphocephala*) on sandy soils, swamp sheoak (*Allocasuarina obesa*) on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland while the outwash plains, once dominated by *A. obesa* – marri woodlands and *Melaleuca* shrublands, are extensive only in the south (Environment Australia 2000).

At the time of writing this plan, some 15.3% of the Swan Coastal Plain bioregion was vested in the Conservation Commission. It is proposed in the *Forest Management Plan 2004–2013* (Conservation Commission of WA 2004) that this will increase to 17%, of which 0.03% will be represented in the planning area.

Forrestdale Lake is one of four internationally important and 26 nationally important wetlands in the Swan Coastal Plain bioregion (CALM 2003).

### GEOLOGY, LANDFORM AND SOILS

The geomorphic elements of Forrestdale Lake are typical of the Swan Coastal Plain. The planning area is situated in the Perth Basin, on the eastern edge of the gently undulating Bassendean Dunes, which comprise predominantly leached grey-white siliceous sands, are the oldest of the three Aeolian dune systems. The lake itself is a deflation basin rimmed by low sand ridges up to five metres, and lakebed sediments that comprise sand to sandy organic mud overlying soft marly limestone and clayey sand (ANCA 1996), and a sandstone outcrop is present on the north eastern margin of the lake (CALM 1987). Lake deposits up to 2 m thick underlie Forrestdale Lake and include silt, clay, peat, diatomite, marl and freshwater limestone (ERM Mitchell McCotter 2000).

The geomorphology of the lake indicates that it began developing 5000 to 6000 years ago, and it is thought to have been part of an ancient river system (Giblett 1993). The lake is most likely underlain by pyritic peaty sediments, which are potentially acid sulphate soils<sup>5</sup>. The Swan Catchment Council (2004) identified Forrestdale Lake as having a high risk of acid sulphate soils (i.e. less than 3 m from the soil surface). This means that extensive digging (e.g. for *Typha* removal), dewatering or drainage has the potential to cause considerable environmental damage if management does not consider this issue.

Other potential threats to the landform and soils of the planning area include erosion from uncontrolled horse riding and trail bikes. These issues have been addressed in this plan (see *Managing Visitors*).

## WETLAND AND CATCHMENT MANAGEMENT

### Hydrology

Forrestdale Lake is a surface expression of groundwater that has formed where the water table intersects with the ground surface. It has an area of open water covering approximately 221 ha, or 90% of the existing nature reserve, when full, and is one of 12 Ramsar sites in Western Australia and one of only four within the Swan Coastal Plain bioregion. The ability of the lake to support waterbird populations depends on the presence and quality of water, both of which are directly affected by climate, surrounding land use practices and groundwater management.

Forrestdale Lake is situated on the eastern margin of the Jandakot Groundwater Mound where the mound intersects the Perth Groundwater Area. The mound is a region of elevated groundwater table beneath the Swan Coastal Plain. Groundwater discharges from the mound into low lying depressions that support groundwater dependent vegetation and extensive wetland systems, the most notable of which are Forrestdale and Thomsons Lakes.

Wetland ecosystems such as Forrestdale Lake are affected by events that cause variations to the quality and quantity of groundwater supply. Examples of these events include rainfall and modified land uses within catchments (such as groundwater extraction and urban development). In order to protect the wetland ecosystem and maintain its ecological character and viability as waterbird habitat, the impacts of climate change, groundwater extraction and existing and proposed land uses within the Forrestdale Lake catchment need to be understood and managed.

Management of water resources on the Jandakot Mound is the responsibility of the Department of Environment (DoE), which, as Western Australia's primary water resources manager, is responsible for the conservation, protection and management of water resources within and surrounding the planning area. However, CALM, as the

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<sup>5</sup> Acid sulphate soils are waterlogged soils that contain iron sulphide minerals, predominantly as the mineral pyrite. The exposure of the pyrite to air by drainage, dewatering or excavation of soil can generate sulphuric acid. Water in contact with the oxidising soil leaches metals from the soil, which then discharges into waterways as acidic water.

land manager of the nature reserve, acknowledges that there are overlapping responsibilities with DoE for the management of the lake and activities external to the planning area that impact on how the lake is managed.

#### **Managing water levels**

Changes in water levels are a significant management issue at Forrestdale Lake. The water level of Forrestdale Lake responds to events that cause variations in the quantity of groundwater supply, evidence that the lake is strongly controlled by the local hydrology (ERM McCotter 2000).

Wetlands in the south west of Western Australia are influenced greatly by the Mediterranean climate, and it is a normal occurrence that water levels rise during the wetter winter months and decrease dramatically in summer. This seasonal hydrological cycle creates biological, chemical and physical characteristics unique to the Swan Coastal Plain wetlands.

Long-term groundwater levels, and hence lake water regimes, are controlled by long-term climatic conditions. As a consequence of an increasingly drier climate, particularly since the 1970s, groundwater levels on the Jandakot Mound have progressively decreased, thereby increasing pressure on groundwater supply. Also, water abstractions have, at times, exceeded management limits (Water and Rivers Commission 2001).

Accordingly, the water regime at Forrestdale Lake is very much influenced by climate, and seasonal drying is a feature of the lake. This is due to evaporation, and so the duration and time of drying depends on evaporation rates and the amount of water entering the lake during winter and spring. The major factors affecting maximum water levels are winter rainfall and drainage (Department of Environment 2004). Therefore, in wetter years, the lake does not tend to dry up, whereas in more recent drier years, it has dried up completely in summer.

Surface water levels were much higher at Forrestdale Lake in the 1970s and 80s, and have been steadily declining since 1992. Groundwater levels have also decreased since records commenced in 1996 (Water and Rivers Commission 2003a in Froend *et al.* 2004). Results from Stage 1 of the Section 46 review of the Gngara and Jandakot Groundwater Mounds indicate that water levels in Forrestdale Lake are currently about 1.5 to 2.5 m below levels observed in the 1970s and 1980s (Department of Environment 2004). Also, the lake is now drying earlier than in previous wetter years, which has resulted in the encroachment of vegetation (predominantly *Typha orientalis*) onto the lakebed, subsequently decreasing the amount of mudflats available for wading birds, and therefore reducing the habitat value of the lake for waterbirds (Department of Environment 2004).

Whilst the low water levels have resulted in increased growth and spread of *T. orientalis*, they have had the positive impact of eliminating the midge problems of previous wetter years at Forrestdale Lake when nutrient enrichment was higher.

As well as being affected by climate, the water regime at Forrestdale Lake is changing as a result of human activities and associated impacts

(i.e. from surrounding land-uses). As urban development increases around the planning area, so do the threats to the lake. Such changes may see the lake alter from being groundwater dominant to surface water dominant as surface runoff from urban areas increases and groundwater levels decrease (J. Davis, pers. comm. 2004). Other factors contributing to pressures on the groundwater include water abstractions, changes in vegetation cover and the increasing presence of impervious surfaces associated with urbanisation.

In 1992 Environmental Water Provisions (EWPs) were set for a number of wetlands across the Jandakot Mound, including Forrestdale Lake, under Section 46 of the Environmental Protection Act. These EWPs include a preferred minimum water level and an absolute minimum level, and were set to ensure the maintenance of the lake's habitat value for migratory birds and rare, threatened and priority flora and fauna.

These Ministerial conditions were under review at the time this plan was being written, following breaches at a number of sites across the Jandakot Mound, including Forrestdale Lake. The breaches mainly occurred as a result of water extractions being excessive given the declining groundwater levels resulting from drier climatic conditions. In September 2001, the EPA endorsed a two-stage approach to a review of the Ministerial conditions of environmental approval for management of the shallow groundwater resources of the Jandakot Mound. This arose from a Water and Rivers Commission (now DoE) request to the Minister for the Environment for a review of the existing Ministerial conditions due to consistent transgressions. The Minister for the Environment subsequently asked the EPA to 'inquire into, and advise on, changes to the Ministerial conditions' (Water and Rivers Commission 2003).

At the time of writing this plan, Stage 2 of the project was underway. It includes the provision of revised environmental criteria relating to ecological values such as wetland and terrestrial vegetation and macroinvertebrates, as well as identification of parameters and a framework for appropriate on-going monitoring programs.

Climate variability, long-term groundwater level behaviour and abstraction management will also be considered as part of the Section 46 review and, subsequently, a revised management program and water resource management plan will be developed for the Jandakot Mound.

The Stage 1 report of the Section 46 review (Department of Environment 2004) proposes a number of amendments to the management criteria and Ministerial conditions for the Jandakot Groundwater Scheme Stage 2, including specific changes for groundwater and wetland water level criteria for the Jandakot Mound. The ecological values at Forrestdale Lake require a natural cycle of filling and drying to continue, with maintenance of water levels above a preferred summer minimum of 21.6 m Australian Height Datum (AHD) and an absolute summer minimum of 21.1 m AHD. At the time of writing this plan, the statutory preferred minimum water levels of Forrestdale Lake were not proposed to change, pending further investigation into the relationship between groundwater and wetland levels at Forrestdale Lake (Department of Environment 2004). A

permanent vegetation transect has been set up at Forrestdale Lake as part of this study, which will be monitored by DoE.

There is also a requirement for water depth of at least 0.9 m when levels are at their annual maximum. In wet years the lake should be dry by April, by February/ March in medium years and by January in dry years (Department of Environment 2004).

Monitoring of both surface water levels and groundwater levels at Forrestdale Lake is the responsibility of DoE, as part of the environmental conditions on the management of the Gngara and Jandakot Groundwater Mounds. DoE have monitored water levels at Forrestdale Lake on a monthly basis since 1996, and it is important that this continues in order to ensure the protection of the lake's Ramsar values.

Low water levels over recent years have contributed to the spread of *Typha orientalis* and its encroachment onto the lakebed is an issue for management (see Environmental Weeds).

#### **Managing water quality**

A number of factors influence the water quality of Forrestdale Lake, particularly groundwater discharge. During dry years in particular when drain flow is either minimal or non-existent, discharge from groundwater contributes about 99%, or effectively the entire nutrient load into the lake. During periods of rainfall, drain discharges into the lake can also be a source of nutrient input (ERM Mitchell McCotter 2000).

Forrestdale Lake is a fresh/brackish wetland and often experiences elevated nutrients as a result of rural activities within the catchment (Wild and Davis 2004). The lake has a history of poor water quality and of being highly enriched. The current dry climatic phase has removed some of these issues, such as eutrophication and subsequent high levels of midges, but if the climate becomes wetter again, the same associated problems will mostly recur (J. Davis, pers. comm. 2004).

Concentrations of total phosphorus above 150 mg/L are usually associated with poor water quality and nuisance midge swarms. Nuisance swarms of non-biting midges (Chironomids) are an indicator of poor water quality in the lake. Densities of larval midges that reflect high levels (i.e. in excess of 2000 larvae/m<sup>2</sup>) are considered to occur as a result of an abundant algal food source, which, in turn, is a response to nutrient enrichment.

Water quality and macroinvertebrates were studied at Forrestdale Lake between spring 2001 and summer 2004 as part of a program to monitor wetlands potentially affected by the Jandakot Groundwater Scheme Stage 2. Forrestdale Lake was added to the study as a control site for this research, as it doesn't lie directly over the Jandakot Mound and therefore is not influenced by abstraction of groundwater due to the Groundwater Scheme.

Ongoing water quality monitoring of Forrestdale Lake is undertaken annually by CALM, with the assistance of the Friends of Forrestdale,

and in consultation with DoE. However there is no water quality monitoring program that provides regular seasonal data for Forrestdale Lake. This is an issue that needs to be addressed by all managing agencies, including CALM and DoE.

ERM Mitchell McCotter (2000) conducted a baseline nutrient study at Forrestdale Lake and found that groundwater containing nutrients discharges into the lake predominantly from the west. James Drain, on the west side of the lake, along with Skeet Drain to the north, also contributes nutrients into the lake during wetter years. James Drain originates from the Taylor Road wetlands and Bangup Swamp, and flows through adjacent farmlands, whilst Skeet Drain flows from nearby Skeet Oval (Map 2). The nutrients they carry originate from a variety of point and diffuse sources associated with rural land use, including intensive animal feedlots and pens, and fertilised crops and gardens. Groundwater impacted by nutrients from residential land use in the Forrestdale Township also discharges into the lake (ERM Mitchell McCotter 2000). CALM will liaise with the Water Corporation to pursue the issue of sewerage in the Forrestdale Township to reduce the amount of nutrients potentially leaching into Forrestdale Lake.

The Water Corporation is responsible for the management of the Forrestdale Main Drain, an overflow drain which runs from the lake's eastern side in a northerly direction (Map 2). It has not flowed now for a number of years and is not currently an issue for management.

With the exception of rainfall, there are generally no natural surface water inflows to the lake. There are three nearby roadway drains (Weld, Fisher and Moore). However, these discharge into the groundwater and thus surface water from them does not directly enter the lake (ERM Mitchell McCotter 2000).

The management of water quality at Forrestdale Lake requires the consideration of two possible scenarios:

1. A wetter phase, which could lead to a sharp increase in nutrient enrichment and issues with odours, toxic algae and midges. There is the potential for future problems under a higher rainfall scenario because increased rainfall will result in the flushing of nutrients from the surrounding catchment.
2. The continuation of the current dry phase causing the lake to dry out prematurely. With the current summer drying regime at Forrestdale Lake, the release of nutrients from lake sediments is not as continuous as would occur under a permanent water regime. The drying of the lake is assisting in reducing phosphorous levels in the surface water of the lake. Nutrient export during such dry phases occurs through a variety of mechanisms, including use of nutrients by plants and animals, volatilisation of the nutrients to the atmosphere, wind blowing the nutrients (in the form of dead plant and animal material) out of the dry lake, and oxidation of nutrients so that they are accessible and used as soon as the lake floods instead of accumulating over time (S. Halse, pers. comm. 2004). Elevated nutrient levels have been recorded in the past, and the potential for further nutrient enrichment remains high (J. Davis, pers. comm. 2004).

Threats to wetland values can be mitigated by vegetative or other buffers, which are vital in maintaining the health of the system and habitat diversity (Bowen *et al.* 2002). The vegetation buffer surrounding Forrestdale Lake is not all that significant, hence the problems of midge swarms during wetter climatic regimes. Wetland fringing vegetation should be re-established in degraded areas around the lake to reinforce the buffer (see Rehabilitation).

Many of the ecological problems facing Forrestdale Lake, and other lakes on the coastal plain, relate to whole of catchment issues. The appropriate management of adjoining land and vegetation is of major importance for the effective conservation of all wetland types. Integrated catchment management is a process to help coordinate the management of factors affecting water quality on a catchment-wide basis. Integrated catchment management initiatives need to be established for the catchment of Forrestdale Lake to minimise the effects of water pollution and nutrients entering the wetland system. A comprehensive catchment management plan for the Forrestdale Lake catchment needs to be prepared. It should integrate town planning and land use considerations with the protection and enhancement of water resources. The agencies involved in this would include the City of Armadale, DoE and CALM. The catchment management plan should include environmental water provisions and performance indicators relating to water quality and wetland health.

The control of diffuse sources of pollution is one of the major issues of wetland management. Mechanisms to ensure that water quality is not adversely impacted by existing and future landuse practices on adjoining land needs to be considered on a regional, catchment-based level. This could possibly be done under the umbrella of the existing Armadale Gosnells Landcare Group Inc. (AGLG) or via a formalised arrangement between this group and the Nutrient Study Group<sup>6</sup>. Community education may be particularly useful in reducing nutrient runoff catchment-wide. The AGLG, together with the Department of Agriculture, have offered property management courses for landholders in the Forrestdale area, which includes information on managing properties to reduce nutrient loss and, hence, input into the drainage system.

The City of Armadale has indicated that the AGLG, in conjunction with the City (through its Streamcare Program) could assist in the management of James Drain, which is crucial to the water quality of the lake.

The EPA has developed guidelines to ensure that any proposed changes to landuses within the catchment of an important wetland will not impact on the water quality or hydrology of the wetland. Groundwater Environmental Management Areas (EMAs) have been identified to assist with future planning in the catchments of significant wetlands such as Forrestdale Lake which have their hydrology dominated by groundwater. The groundwater catchment of Forrestdale Lake is called

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<sup>6</sup> The Nutrient Study Group was established by CALM in accordance with a recommendation in the management plan of 1987, to guide the preparation and implementation of a nutrient study and water quality monitoring program for Forrestdale Lake. The group, which is chaired by CALM, meets annually to review monitoring results, and has representatives from DoE and the Friends of Forrestdale.

an EMA Category A, due to the lake's international significance. As a consequence, new proposals within the lake's groundwater catchment area have to be designed and managed to prevent deterioration of groundwater flowing into the lake (WAPC 2001), and to ensure that nutrient rich water from adjoining developments does not enter the lake.

## NATIVE PLANTS AND PLANT COMMUNITIES

Forrestdale Lake supports a diverse range of vegetation communities and flora characteristic of the original dune systems and wetlands of the Swan Coastal Plain. The planning area is located across the Bassendean Dunes and Bassendean Dunes/Pinjarra Plain landforms, and contains vegetation complexes<sup>7</sup> characteristic of these, as described and mapped by Heddle *et al.* (1980) for the Darling System (in State of Western Australia 2000). These are the Bassendean Complex - Central and South, on the Bassendean Dunes, and the Southern River Complex on the Bassendean Dunes/Pinjarra Plain association (State of Western Australia 2000).

Within the Bassendean Complex - Central and South, the vegetation ranges from woodland of *Eucalyptus marginata* – *Allocasuarina fraseriana* – *Banksia* spp. to low woodland of *Melaleuca* species, and sedgeland on the moister sites. Within the vicinity of Perth, it also includes a transition of *E. marginata* to *E. todtiana*.

The Southern River Complex comprises open woodland of marri (*Corymbia calophylla*) – *E. marginata* – *Banksia* species with fringing woodland of *E. rudis* – *M. raphiophylla* along creek beds.

On a less broad scale, Gibson *et al.* (1994) classified the vegetation complexes into floristic communities. Six of the 43 floristic community types and subtypes of the southern Swan Coastal Plain are represented in the planning area, two of which are threatened (see Threatened Ecological Communities):

- Community Type 4 *Melaleuca preissiana* damplands;
- Community Type 8 Herb-rich shrublands in claypans;
- Community Type 10a Shrublands on dry clay flats;
- Community Type 12 *M. teretifolia* and/or *Astartea* aff. *fascicularis* shrublands;
- Community Type 21a Central *Banksia attenuata* – *Eucalyptus marginata* woodlands; and,
- Community Type 21c Low-lying *B. attenuata* woodlands or shrublands.

(State of Western Australia 2000)

Keighery *et al.* (2001) surveyed the vascular flora of Forrestdale Lake Nature Reserve and identified 351 taxa. Of these, 252 are native and 99 are introduced.

Within the planning area there are two 'Declared Rare Flora' species; Purdie's donkey orchid (*Diuris purdiei*) and the glossy-leaved hammer orchid (*Drakaea elastica*), and two Threatened Ecological Communities (see over).

<sup>7</sup> Vegetation complexes are groupings of vegetation types, developed on units characterised by particular soil, geomorphic and climatic characteristics (State of Western Australia 2000).

There are also five Priority taxa: one Priority 1<sup>8</sup> (*Acacia lasitocarpa* subsp. *bracteolata*), and four Priority 4<sup>9</sup> species (*Villarsia submersa*, *Drosera occidentalis*, *Verticordia lindleyi* subsp. *lindleyi* and *Anthotium junciforme* (State of Western Australia 2000).

In addition to these there are five species that are significant for a variety of reasons: *Pimelea imbricata* var. *major* (significant populations), *Villarsia violifolia* (significant populations, and considered to be poorly reserved), *Burchardia bairdiae* (significant populations, and populations at the northern or southern limit of their known geographic range), *Leptocarpus* sp. Forrestdale Lake (significant populations) and *Myriocephalus helichrysoides* (taxa endemic to the Swan Coastal Plain) (State of Western Australia 2000).

The floristic values of the planning area are vulnerable to potential threats from surrounding landuses, such as agriculture and urban development. Most of the lake has only a very narrow strip of fringing vegetation that provides very little buffer to such threats, which include decreasing water levels, run-off and drainage, unplanned fire, dieback and weeds. It is essential that any new development proposals on nearby land are assessed under both the *Environmental Protection Act 1986* and the *Town Planning and Development Act 1928* to ensure they will have minimal impacts on the planning area's biodiversity values.

Other threats to the vegetation include declining water levels, which have affected fringing vegetation around the lake, including *Melaleuca raphiophylla* and *Eucalyptus rudis* (Ladd 2001, in Department of Environment 2004), disease and frequent fire.

#### **Threatened Ecological Communities**

There are currently 68 Threatened Ecological Communities (TECs) listed in Western Australia, all of which are protected under the EPBC Act. Two TECs are recorded in the planning area. One is type 8 – 'Herb-rich shrublands in clay pans', and the other type 10a – 'Shrublands on dry clay flats'.

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<sup>8</sup> Priority 1 flora are species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation (e.g. agricultural or pastoral lands, urban areas, shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation). Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

<sup>9</sup> Priority 4 flora species are categorised as either Rare, Near Threatened or other species in need of monitoring:

- a Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
- b Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
- c Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Community type 8 consists of clay pan communities that can be dominated by *Viminaria juncea*, *Melaleuca viminea*, *M. lateritia* or *M. uncinata* but occasionally by *Eucalyptus wandoo*. Aquatic annuals are also common (Gibson *et al.* 1994). Community type 8 is listed in Western Australia as 'vulnerable'.

Community type 10a forms on the most rapidly drying of the clay flats. It contains aquatic annuals and geophytes such as *Schoenus natans*, *Crassula natans* and *Amphibromus neesii* (Gibson *et al.* 1994). Community type 10a is listed in Western Australia as 'endangered'.

The TECs that occur in the planning area will be managed for conservation. In particular, this will involve control of threatening processes acting upon the communities, especially regional impacts from horses, inappropriate fire regimes, dieback disease caused by the plant pathogen *Phytophthora cinnamomi*, altered groundwater levels or quality, weed invasion and off-road vehicles.

The Western Australian Threatened Species and Communities Unit within CALM co-ordinates, assists and promotes the conservation of threatened species and ecological communities on private and public land in Western Australia.

## NATIVE ANIMALS AND HABITATS

Forrestdale Lake is especially significant as a wetland habitat. In total, 146 native bird species have been recorded in the planning area, including 81 terrestrial species and 65 species of waterbirds. The lake regularly supports more than 10 000 waterbirds, including 21 species protected under JAMBA and/or CAMBA, and 19 migratory species (see Migratory Waders) (Burbidge and Birds Australia WA 2002). The highest number of waterbirds counted at the lake was 21 083 in February 1987, ranking it ninth in the region (ANCA 1996). Up-to-date information on the birds at Forrestdale Lake can be found in Birds Australia's *New Atlas of Australian Birds* (2003).

The lake is an important feeding area for an exceptionally wide variety of waterbirds, and provides habitat for 16 habitat specialists with a reduced distribution on the Swan Coastal Plain (birds) and nine wide-ranging bird species that have reduced populations on the Swan Coastal Plain (State of Western Australia 2000).

The planning area supports two fauna species listed on CALM's Priority Fauna List: a native bee (*Leioproctus contrarius*), which is Priority 3<sup>10</sup>, and the quenda (*Isodon obesulus fusciventer*), a Priority 5<sup>11</sup> species on CALM's Priority Fauna List. Also occurring within the planning area are two specially protected species of native bee and one specially protected bird species that are listed under the Wildlife Conservation

<sup>10</sup> Priority 3 fauna species are taxa that are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

<sup>11</sup> Priority 5 taxa are taxa in need of monitoring, i.e. that are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Act: *Leioproctus douglasiellus* and *Neopasiphae simplicior*, and Carnaby's black-cockatoo (*Calyptorhynchus latirostris*) (Wildlife Conservation (Specially Protected Fauna) Notice 2004).

The peregrine falcon (*Falco peregrinus*), which is also specially protected under the Wildlife Conservation Act, has been recorded in many parts of the metropolitan area and may occur in the planning area (Wildlife Conservation (Specially Protected Fauna) Notice 2004).

Very limited surveying for native mammals has occurred in the planning area, and available data dates back prior to 1987. However at that time, four mammal species had been identified at Forrestdale Lake; the quenda, the western grey kangaroo (*Macropus fuliginous*), the white-striped mastiff bat (*Tararida australis*) and the western brush wallaby (*M. irma*), which is believed to no longer inhabit the planning area.

Seven species of frogs and 15 reptile species comprising nine lizard species, five species of snake and one tortoise, the long-necked tortoise (*Chelodina oblonga*) have been recorded at Forrestdale Lake. Three of the reptile species are significant because they are scarce or rare in the area and have relatively localised distributions: the swamp skink (*Acritoscincus trilineatum*), lined skink (*Lerista lineata*) and crowned snake (*Notechis coronatus*) (State of Western Australia 2000).

Threats to native fauna and their habitats include inappropriate water levels and water quality (see *Wetland and Catchment Management*), introduced animals (see *Introduced and Other Problem Animals*), loss of habitat from unplanned fire (see *Fire*), and weeds (see *Environmental Weeds*).

#### **Migratory waders**

Forrestdale Lake is an internationally important wetland, providing habitat for 19 species of migratory waders that use the lake on a seasonal basis. The most abundant of these species (with their maximum numbers recorded shown in brackets) are the red-necked stint (3000), curlew sandpiper (2000) and sharp-tailed sandpiper (700). The next most abundant species are the long-toed stint (80), the marsh sandpiper (60) and the wood sandpiper (32) (Burbidge and Birds Australia WA 2002). Between 1981 and 1985, 14 species cited in the JAMBA treaty were recorded at the lake (Jaensch *et al.* 1988). Forrestdale Lake is one of the few sites in Western Australia where little ringed plover (*Charadrius dubius*) and little stint (*Calidris minuta*) have each been recorded more than once, and is the only WA locality for white-rumped sandpiper (*C. fuscicollis*) (ANCA 1996).

Exposed mudflats around the lake are essential habitat and feeding ground for migratory waders. To ensure the continued presence of such birds at Forrestdale Lake, it is essential that the amount of both *Typha orientalis* and, where appropriate, native emergent rushes and sedges be controlled to prevent encroachment onto the lakebed. This will ensure that exposed mudflats remain available for utilisation by wading birds.

Up to date information on the bird species recorded at Forrestdale Lake can be found in the *New Atlas of Australian Birds* (Barrett *et al.* 2003).

### **Macroinvertebrates**

Macroinvertebrates have been the subject of several studies at Forrestdale Lake, including a broad survey of wetlands on the Swan Coastal Plain in 1989/1990, and more recently, a monitoring program has been undertaken (between spring 2001 and summer 2004) by Murdoch University as part of a program to monitor wetlands potentially affected by the Jandakot Groundwater Scheme Stage 2.

Monitoring has revealed that a large diversity of species exist at Forrestdale Lake. Macroinvertebrates from a total of 28 families were collected from the lake over the monitoring period 2001-2004. These included one mollusc, eight crustaceans, three arachnids and fifteen insect species (Wild and Davis 2004). Additionally, previous studies indicate that at least 62 aquatic invertebrate taxa occur in the lake (Department of CALM 2003a). Results of previous sampling at Forrestdale Lake are published in Davis and Christidis (1997).

The mean and total number of macroinvertebrate families recorded appears to be greatly influenced by water depth, with lower mean species richness recorded in dry years than wetter years. The greatest number of families collected was from emergent macrophyte habitat (Wild and Davis 2004). Both submerged and fringing plant communities provide important habitat for macroinvertebrates at the lake. More habitat is likely to be provided in wetter years when more of the fringing vegetation is flooded.

Comparison of data collected in 1989/1990 and between 2001 and 2004 indicates that the richness of invertebrate fauna at Forrestdale Lake appears to have remained stable over the intervening time period.

The results from a study of aquatic macroinvertebrates across a series of wetlands on the Jandakot Mound indicate that the overall effects of climate change (i.e. less rainfall and the corresponding decrease in wetland water levels) may be greater than other less broad scale impacts associated with individual wetlands (such as eutrophication, weed invasion and heavy metal pollution) (Wild and Davis 2004).

Macroinvertebrates are an important component of wetland food webs, comprising much of the diet of many faunal species, including migratory waders and other waterbirds, and tortoises (CALM 2001). Additionally, they may act as indicators for the assessment of wetland health (Davis *et al.* 1993). A biotic index, SWAMPS (Swan Wetlands Aquatic Macroinvertebrate Pollution Score), was developed for wetlands on the Swan Coastal Plain by Chessman *et al.* (2002), whereby numerical values were assigned to wetland macroinvertebrate families to reflect their sensitivities to nutrient enrichment. SWAMPS values recorded for Forrestdale Lake during the study period indicate that nutrient enrichment (eutrophication) is an issue of ongoing concern at the lake (Wild and Davis 2004). However, the negative impacts of enrichment, such as the occurrence of large swarms of non-biting midges in summer, have not been evident in recent years because the lake has been dry over the summer period (see *Midges*).

## ENVIRONMENTAL WEEDS

The *Environmental Weed Strategy for Western Australia* (CALM 1999) describes environmental weeds as "... plants that establish themselves in natural ecosystems and proceed to modify natural processes, usually adversely, resulting in the decline of the communities they invade". Weeds displace indigenous plants, particularly on disturbed sites, by competing with them for light, nutrients and water. Some of their other impacts include the prevention of seedling recruitment, changes to soil nutrients, and changes to the abundance of indigenous fauna. They can also have a significant adverse impact on other conservation values by altering animal habitats, harboring pests and diseases, and increasing fire hazard or changing fire regimes.

The Environmental Weed Strategy provides an integrated approach to weed management, and rates environmental weeds as high, moderate, mild or low based on their potential invasiveness, distribution and environmental impacts. This rating provides the basis for identifying control priorities, with the highest rated species, and species that pose a specific threat to conservation values, being the focus for weed management. Within the planning area, the most invasive species are targeted first for control, along with those rated as high in the statewide strategy. Also taken into consideration are other local concerns such as ongoing maintenance to limit the return of species that have been previously removed.

CALM will develop a Weed Control Plan for the planning area, which will provide further direction for on-going weed control (see the management summary table). Further guidance for management is provided by *Policy Statement No. 14 – Weeds on CALM Lands* (CALM 1986).

Ninety-nine exotic plant species have been identified in the reserve (Keighery *et al.* 2001). As rated in the Environmental Weed Strategy there are 14 High impact species, 52 Moderate, 13 Mild, 17 Low, and three species that are either unlisted or not rated. Introduced bulrush (*Typha orientalis*), pampas grass (*Cortaderia selloana*), bridal creeper (*Asparagus asparagoides*) and arum lily (*Zantedeschia aethiopica*) are four that have a High rating, and which pose the most threat to native vegetation in the planning area. To date, a works program has been implemented to remove each of these species. This is on going to control re-infestations. Weed issues are greater on the western side of the lake as a result of past land clearing and grazing practices.

Introduced bulrush, an aggressive colonizer in disturbed environments, has the potential to further reduce the area of open water and invade the emergent native vegetation, and is a major management issue at Forrestdale Lake. Furthermore, as the lake dries in summer, the bulrush dries off presenting a significant fire hazard. The colonisation and spread of *Typha orientalis* around Forrestdale Lake has the potential to significantly displace and change fringing vegetation and hence alter waterbird habitat. This has been occurring over the last few years as a result of the lower water levels in the lake.

As the inter-relationship between soil disturbance, weed invasion and native plants is complex, weed control should be undertaken in a

strategic and integrated manner with guidance from the Environmental Weed Strategy. Rehabilitation of areas following weed removal is important to prevent re-invasion of weed species (see Rehabilitation).

As stated previously, exposed mudflats around the lake are essential habitat and feeding ground for migratory waders. To ensure the continued presence of such birds at Forrestdale Lake, it is essential that the amount of *T. orientalis* be controlled to prevent encroachment far enough onto the lakebed that it impedes the habitat of wading birds, and to ensure that exposed mudflats remain available for utilisation by such birds. Strategies for the continued management of *T. orientalis* in Forrestdale Lake Nature Reserve have been identified in this management plan, and a KPI has been included in the plan to reduce the amount of *Typha* by at least 3% every report period (three years) (see *Environmental Weeds* in the management summary table).

## INTRODUCED AND OTHER PROBLEM ANIMALS

Problem animals are those species that have the potential to cause serious impact on natural systems through direct effects such as predation, habitat destruction, competition for food and territory, and introduction of disease, and through environmental degradation (e.g. by over-grazing). Problem animals can be either native species that are impacting on natural or agricultural values, or feral animals (introduced species that have become established as wild or naturalised populations).

A primary operational objective of CALM is to achieve the systematic and safe control or eradication of introduced and other problem animals according to an agreed priority dependant on:

1. the impact of the animals;
2. the efficiency and effectiveness of control measures;
3. participation of other stakeholders; and
4. the capacity for long term monitoring of the population.

Introduced animals recorded in the planning area include foxes (*Vulpes vulpes*), feral cats (*Felis catus*), feral honeybees (*Apis mellifera*), rabbits (*Oryctolagus cuniculus*), black rats (*Rattus rattus*) and house mice (*Mus musculus*).

A *Pest Animal Control Plan* (CALM 2004a, in prep.) relevant to reserves on the Swan Coastal Plain is being prepared by CALM's Regional Parks Unit. It is proposed that control of problem animals within the planning area will be consistent with the control plan, and in accordance with operational priorities.

Foxes and cats are present in the planning area. However, the extent of their impact is currently unknown. In recent drier years, foxes have been seen within the nature reserve preying on young cygnets (D. James, pers. comm. 2002). The only effective broadscale method of fox control is baiting using 1080, a poison that is not appropriate at Forrestdale Lake due to its close proximity to urban areas. Should alternative fox control methods, suitable for use in the planning area, be developed over the life of this plan, CALM will investigate the implementation of them at Forrestdale Lake.

No feral cat control is currently undertaken or proposed to be undertaken in the planning area. Cat baiting is being trialled in some areas of the state. However it is not feasible within the planning area due to its proximity to urban areas. The City of Armadale is currently undertaking research into the possibility of introducing cat controls. The research involves assessing the effects of a cat free zone, measuring cat density and radio-tracking cats to determine their activity and how far they move, with the aim of investigating the feasibility of introducing a cat curfew for some areas of the City. Should this initiative occur in the Forrestdale Township, CALM would support it.

Rabbit control measures will be considered where rabbits are adversely affecting revegetation works.

The introduced (or feral) honeybee is present in the planning area although it is not thought to be a major problem. Feral beehives may be removed as necessary on a case-by-case basis.

The control of these species will be considered in the Pest Animal Control Plan that is currently being developed by CALM, and which is relevant to reserves on the Swan Coastal Plain, such as Forrestdale Lake, and will occur in accordance with operational priorities.

#### **Midges**

Non-biting midges (Chironomids) inhabit the wetlands of the Swan Coastal Plain, and have been the subject of complaints by local residents at Forrestdale Lake for many years. Davis and Christidis (1997) identified Forrestdale Lake as a problem site for midges, due to the townsite being situated on the north east corner of the lake in the path of prevailing south westerly breezes. Research shows that while midges are a natural component of aquatic ecosystems in Perth wetlands, nutrient enrichment promotes higher densities of midge larvae. Hence, midge problems are partly a symptom of a disturbed system and a consequence of poor water quality (Pinder *et al.* 1991). The problem has been exacerbated at Forrestdale Lake, as there is very little buffer between the lake and adjacent residential areas, as buffers can assist in reducing the impact of pest insects (Bowen *et al.* 2002). However, there have been few problems from midges over the past few years as a result of the low rainfall in the Perth region, which has resulted in the lake drying out early in summer before major midge swarms develop.

The City of Armadale began aerial spraying of the lake in 1975 to control the number of midge larvae. Since that time, the lake has been treated on an as-needs basis, as often as two or three times a year during spring and summer, using a granulated organo-phosphate known as Temphos. Currently, CALM undertakes and manages the aerial treatment of the lake as necessary, under a joint funding arrangement with the City of Armadale.

To help address the midge problems occurring at Forrestdale Lake, a monitoring program conducted by Murdoch University commenced in 1987, and a District Control Plan for treatment was put in place in 1991. Monitoring needs to continue to guide how and when treatments occur.

However, there is some concern about the impact of Temphos, both on macro-invertebrates and the entire food chain. As a precaution, and to

ensure waterbirds do not ingest Temphos granules, the lake is not treated if the water level is less than 30 cm in depth.

## DISEASE

### **Disease caused by *Phytophthora***

The most significant disease threat to plants and fauna habitats within the planning area is the disease known as 'dieback', caused by the microscopic pathogen *Phytophthora cinnamomi*. It is thought that this pathogen was introduced during European settlement of Western Australia through the soil around roots of plants brought over for cultivation. There are now known to be eight species of *Phytophthora* occurring within the native plant communities of Western Australia, of which *P. cinnamomi* is recognised as the most damaging. Once infected, susceptible plants are killed and, in many cases, eliminated from the site. This could lead to dramatic and permanent changes to native plant communities and their dependent fauna.

The south-east section of the nature reserve is infected with *P. cinnamomi*. However, at the time of writing this plan, a comprehensive survey had not been conducted of the entire planning area. A Dieback Management Plan will be developed for Forrestdale Lake, which will include timeframes for resurveying and the required notification for quarantine areas.

Management of *P. cinnamomi* within the planning area will remain focused on constraining, as far as possible, the human-assisted establishment of new infestations within disease-free areas, as well as the minimisation of spread within and from existing infections. It is equally important to ensure that soil imported into the area is free of *P. cinnamomi*.

Furthermore, significant works that involve disturbing the soil require the preparation of a dieback management plan. Where possible, significant works at Forrestdale Lake should be scheduled for late summer when the chances of spreading *P. cinnamomi* are reduced. Other measures such as appropriate hygiene controls and practices should also be undertaken whenever it is necessary to take vehicles into the reserve or undertake works that disturb the soil, in order to prevent any human induced spread of *P. cinnamomi*.

Management of *P. cinnamomi* at Forrestdale Lake will occur in accordance with CALM's Policy Statement 3 – *Management of Phytophthora and disease caused by it* (CALM 1998a), (which was being revised at the time of writing this plan), and the proposed Dieback Management Plan. It is recommended that a survey for *P. cinnamomi* be undertaken across the entire nature reserve and that ongoing surveys occur as required, but at least every three years.

*P. cinnamomi* could have an impact on revegetation programs if the species used are susceptible to the disease. The risk of impact from the disease can be reduced by modifying activities that spread the pathogen, and by controlling access to highly susceptible areas. Strategies to prevent the introduction of *P. cinnamomi* into uninfected areas, and minimise spread in and from already infected areas, are included in the *Disease* and *Rehabilitation* sections of the management summary table.

## FIRE

Unplanned fire is a significant threat to the natural and cultural values of the planning area. Infestations of introduced bulrush (*Typha orientalis*) are fire hazards because fires in bulrush are difficult to control and can cause damage to fringing vegetation. Frequent wildfire in wetland areas will also prevent the establishment of paperbark vegetation and will lead to an even greater domination of the introduced bulrush. Fire activity also encourages the invasion of *T. orientalis* in wetland areas because it regenerates more rapidly than local rush species.

When managing fire at Forrestdale Lake, CALM is guided by the *Bush Fires Act 1954* and *Policy Statement 19 – Fire Management* (CALM 1987a). This policy was under review and close to being finalised at the time of writing this management plan.

Forrestdale Lake Nature Reserve lies within the metropolitan gazetted fire district, and as such, Fire and Emergency Services (FESA) is the Hazard Management Authority for fire suppression in the planning area. CALM is responsible for pre and post-suppression works.

CALM will complete a Fire Management and Response Plan for the planning area, in consultation with FESA and the City of Armadale, to ensure effective fire management and response to unplanned fire by the responsible agencies. The Fire Management and Response Plan will contain information needed for agencies when responding to a fire, including emergency and contact phone numbers and location of DRF. This information is updated annually prior to the beginning of each fire season.

The Plan also outlines practices such as:

- fire control actions and strategies to protect environmentally sensitive areas from unplanned fire;
- pre-suppression activities including reducing fuel loads by mowing or slashing and maintenance of a system of firebreaks; and
- the maintenance of a fire record system of all fires within the planning area.

There is also an MOU between FESA and CALM, which ensures a coordinated approach to fire management within the planning area.

## PART D MANAGING OUR CULTURAL HERITAGE

### INDIGENOUS HERITAGE

According to Nyungar tradition, wetlands, waterways and lakes, including Forrestdale Lake, are said to be the home of the powerful water serpent figure, the Waugal. The Waugal is spiritually and mythologically important to Aboriginal people who believe that it created rivers and lakes, and maintains the flow of waters that feed its resting places. According to Nyungar beliefs, these places are described as *wimatch* (an area that is avoided, usually for reasons of cultural or religious significance) and consequently require the highest respect and reverence in the way they are considered, used and valued.

It is critical to note that in relation to Nyungar cultural values, this respect and reverence goes beyond the spiritual, and is linked inextricably with environmental integrity. According to Nyungar tradition, the respect and reverence required by a place such as Forrestdale Lake requires a level of awareness and acknowledgement of responsibility from visitors and other users that ensures the ongoing protection and good health of the system.

As well as its mythological status, the lake was a source of tortoise for people from Pinjarra, Mandurah and Armadale. Seasonal camps were usually established under the shelter of surrounding melaleuca scrub in the lake's north-western edge, and some groups set up semi-permanent camps for extended periods on their way from the Darling Plateau to the coast. (O'Conner *et al.* 1989; Gray 1994). Thus, the lake has significance both as a tortoise hunting site, and for these campsites at the lake.

The conservation of Indigenous heritage is important in maintaining the identity, health and well being of Indigenous people (Australian Heritage Commission 2002). In WA, the *Aboriginal Heritage Act 1972* (Aboriginal Heritage Act) protects places and objects customarily used by, or traditional to, the original inhabitants of Australia. A register of such places and objects is maintained under the Act, however, all sites are protected under the Act whether they have been entered on the register or not.

There is one site within the planning area that has been recorded on the Department of Indigenous Affairs' Register of Aboriginal Sites, which is also protected under the Aboriginal Heritage Act: Site S2213, a mythological site.

Forrestdale Lake is covered by one registered native title claim by the Combined Swan River and Swan Coastal Plains Native Title Claimant Group. According to Section 24jb(7) of the Native Title Act, native title claimants and their controlling body must be notified of any public works proposed to be undertaken.

A key issue for management is to ensure that Aboriginal sites are protected from damage, and that obligations are fulfilled according to the Aboriginal Heritage Act and the Native Title Act before any planning or public works occur.

## NON- INDIGENOUS HERITAGE

The first non-Aboriginal settlement at Forrestdale Lake (then known as Lake Jandakot) occurred in 1885, when William and Alfred Skeet were granted a 'Special Occupation' licence for 100 acres adjoining the Lake, as well as licences to cut and sell timber. The area at this time has been described by Popham (1980) as:

*'... rich swamplands ... closely covered by huge paperbark trees, many thirty feet high with a diameter of some three feet, the undergrowth beneath them dense with rough scrub and tanglewood creepers'.*

Early settlers in the Forrestdale Lake area commenced farming in 1893 on the edge of Commercial Road. Large areas of land were soon utilised for farming around Taylor Road, where the water table is close to the

surface. Other settlers soon followed and the Lake Jandakot settlers cleared their land, experimented with crops and ran dairy cattle and poultry as viable commercial ventures (Popham 1980).

By 1898, the area surrounding the Lake had been set aside as a Townsite Reserve and recommendations made regarding subdivision. The Jandakot region soon became a thriving community, producing vegetables, apiary products and in later years, dairy produce for the Fremantle markets. The prosperity of the region encouraged the construction of a railway between Fremantle and Jandakot, which in July 1907 was extended to Armadale for the purpose of transporting goods to the Fremantle Markets (CALM 1987).

From the 1920s intensive agriculture gave way to sheep and cattle grazing, which continued over the next 50 years. During the 1940s the west side of Forrestdale Lake was heavily grazed by sheep and cattle, particularly during the drier summers when land owners used the fringing vegetation to supplement feed from their paddocks (Atkinson, 1984). As a result, the west side of the Lake is devoid of most natural understorey species and is infested with weeds and other introduced plants particularly arum lilies.

In 1957 interest developed in creating a Class A reserve around and including Forrestdale Lake, with the intention that the reserve be used for recreation, particularly sailing. Thus the reserve was gazetted for the 'Protection of Flora and Fauna and Recreation' (CALM 1987). This remained the purpose of the reserve until 1998 when recreation was removed from the purpose and it was changed to 'Conservation of Flora and Fauna'.

The population in the Forrestdale area rapidly increased in the latter half of the 1960s as the townsite blocks to the northwest of the Lake were taken up. Since that time, the population has slowly increased to its current figure of approximately 1350.

Further information on the history of Forrestdale Lake will be available from the Friends of Forrestdale, which has collected and transcribed a large number of oral histories about Forrestdale Lake, to be assembled into a book (Giblett, in prep.).

## PART E MANAGING VISITORS

### VISITOR OPPORTUNITIES

The location of Forrestdale Lake in a developing urban area makes it a valuable place for the local community to undertake passive recreation in a natural environment. The natural values of the planning area provide opportunities for nature appreciation, bird watching, bushwalking and environmental education. As such, visitation to the nature reserve is predominantly for the purpose of birdwatching and walking. In addition, an external trail that runs around some of the perimeter of the reserve, as well as trails on the adjoining recreation reserve, is used by horse riders.

CALM's *Policy Statement 18 – Recreation, Tourism and Visitor Services (subject to final consultation)* (CALM 2004) outlines the Department's

principles, operational guidelines, procedures and administrative controls in relation to facilitating recreation and tourism on CALM managed lands and waters. This management plan follows the policies outlined in Policy Statement 18 where applicable.

As Forrestdale Lake is a nature reserve, gazetted primarily for the purpose of nature conservation, only facilities providing for passive recreation pursuits will be provided. Furthermore, commercial licences will only be considered for passive recreational activities, such as bird watching tours and guided nature walks, which are compatible with both the reserve's purpose and the objectives of this management plan. Applications for such licences will be considered on a case-by-case basis.

## VISITOR USE

Although Forrestdale Lake is primarily reserved for nature conservation purposes, passive recreation that does not impact on natural values or ecosystems of the reserve is permitted. Birdwatching and bushwalking are the main visitor activities at Forrestdale Lake.

Visitor use at Forrestdale Lake is expected to increase over the life of the management plan as urban development on adjoining land goes ahead. This may place increased pressure on the reserve, which needs to be planned for and managed (see Visitor Access). Regional demand for facilities for more active recreational pursuits will be provided for at nearby Jandakot Regional Park (Map 1).

Domestic animals are prohibited in the nature reserve.

### **Birdwatching**

Considering the importance of Forrestdale Lake as waterbird and shorebird habitat, it is not surprising that it is a popular destination for birdwatchers, and that birdwatching represents one of the main visitor activities at the site. To facilitate this, a boardwalk out into the lake was constructed in 1994. However, this was destroyed by fire in March 2003. CALM's Swan Coastal District is currently investigating structure options and funding opportunities for its replacement. Should a replacement structure be built, its design is to be determined in consultation with the community, and should link up to the existing cycleway to provide wheelchair access.

The boardwalk also contained a number of interpretation signs. The signs have recently been cleaned up but are weathered and the information needs updating. This has been addressed in the Interpretation section of this plan.

### **Bushwalking**

Bushwalking is a popular pursuit at Forrestdale Lake. Walkers use the Forrestdale Trail, which is predominantly located around the outside of the nature reserve (Map 3). It is a multi-purpose trail, mainly used by locals, for walking, horse riding and mountain bike riding (R. Giblett, pers. comm. 2003). The trail is included in a brochure produced by the City of Armadale, and there is one interpretive sign, at the end of Moore Street, but no signs on the trail itself. The trail would benefit from improved trail marking and some interpretation signs, which have been addressed in this management plan (see Visitor Access and the management summary table.).

### **Horse riding**

Horse riding is an historical use in the Forrestdale area. The trails within the planning area have long been used by horseriders for both recreation and training. Biological and physical impacts of horse riding can include trampling and grazing of plants, spreading weeds and disease, disturbing native fauna, soil compaction and erosion. The level of impact is dependent on the extent, frequency and intensity of use, topography and soil type.

Horse riding predominantly occurs alongside the existing boundary of Forrestdale Lake Nature Reserve on a limestone trail that runs around the reserve's perimeter (the Forrestdale Trail). It also occurs on an *ad hoc* network of trails throughout the recreation reserve, and on adjoining WAPC land, which is proposed to be transferred to, and vested in, the Conservation Commission as nature reserve (see Land Tenure).

The local community has identified horse riding as a key recreational value of the area, although anecdotal evidence at the time of writing this plan indicates that demand for the activity is decreasing. CALM's Policy Statement 18 states that horse riding will generally not be permitted in nature reserves due to the incompatibility of the activity with the purpose of nature reserves. However, the policy goes on to say that an activity may be permitted where it has been previously allowed and the impacts of the activity can be minimised and controlled. As such, horse riding will be allowed to continue so long as there is a demand for the activity and so long as there are no detrimental environmental impacts resulting in loss or degradation of native vegetation, particularly TECs and DRF species, increased weed invasion or spread of dieback.

A network of bridle trails has been outlined in this plan, which includes a 'dry weather access' only trail, to be closed to horse traffic in winter months (Map 3). No floating areas will be provided at Forrestdale Lake.

No commercial horse riding operations will be permitted in the planning area. Horse riding at Forrestdale Lake will be reviewed over the life of the plan in light of environmental impacts, the demand for the activity and conflicts of use with other visitors. Horse riding will be prohibited in the planning area by CALM if increased erosion, spread of disease or degradation of vegetation occurs as a result of this activity.

### **VISITOR ACCESS**

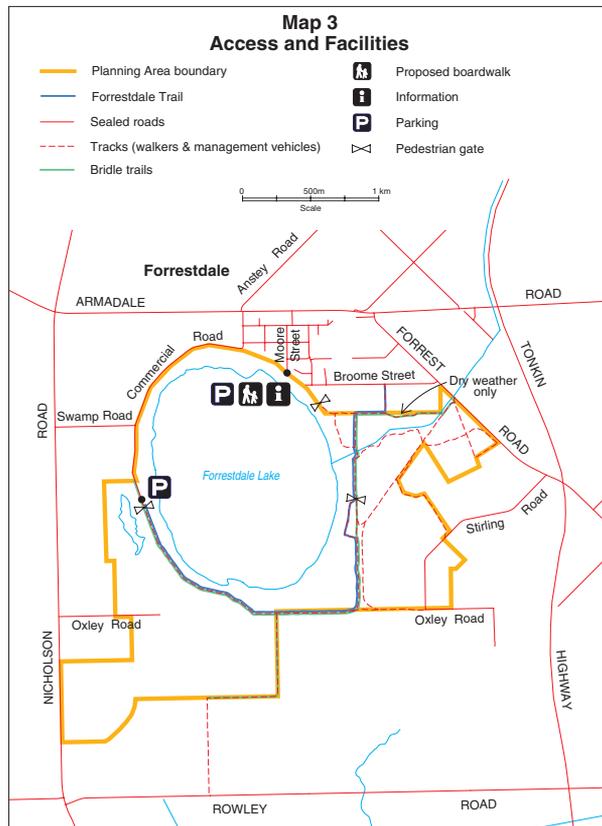
Access within Forrestdale Lake is provided for a limited number of passive recreational uses, as well as for management and emergency vehicles. Unauthorised access to the lakebed is prohibited, with boats being only permitted for management and scientific research purposes.

The current level of access for pedestrians is limited, and the trails are relatively unmarked and often inaccessible in winter. The trails within the planning area are for walkers and horseriders (on designated bridle trails). They also provide access for management and emergency vehicles. At present there is an *ad hoc* network of tracks, particularly in the recreation reserve. There may be opportunities to rationalise these and close and rehabilitate some over the life of the plan, as they

become obsolete. Where possible, trails within the planning area will be linked with existing and future local trails, and the trail system of nearby Jandakot Regional Park.

Access and recreation facilities for the reserve are illustrated in Map 3, which identifies walking tracks and a proposed bridle trail. The walk tracks utilise existing firebreaks and management access tracks, which will be upgraded in sections as required, and signposted.

The greatest threats to the values of the planning area from visitor access are from uncontrolled and unauthorised access by horse and trail bike riders. This is addressed through the provision of fenced bridle trails and it is hoped that antisocial behaviour such as that from trail bike riding will be discouraged by the provision of a formal network of walk and bridle trails, installation of cavalettis on the bridle trails, interpretation signs and a greater sense of ownership of the area by the local community.



## PART F MANAGING SUSTAINABLE RESOURCE USE

### SCIENTIFIC AND RESEARCH USE

There are many opportunities for research within the planning area, including studies of the lake's water quality and levels, groundwater interaction, invertebrates, waterbirds, and of terrestrial flora and fauna. Murdoch University has undertaken research at Forrestdale Lake into the macroinvertebrate community structure since 1989, which can be used as an indicator of wetland health (see Macroinvertebrates). Ongoing research by universities and other groups will continue to be encouraged and supported by CALM.

Ideally, it would be appropriate for research and monitoring programs to involve a wide range of people and groups. The involvement of volunteers, educational institutions and individual researchers can reduce the costs of such programs and assist in providing information to both management and the broader community. Research undertaken in the planning area is to be coordinated by CALM, to ensure an integrated approach that avoids duplication and enables prioritising of projects.

### REHABILITATION

Several areas within the planning area require rehabilitation, particularly the proposed WAPC land additions, and also areas where weed removal will occur as per the proposed Weed Control Plan for Forrestdale Lake. Rehabilitation may also be necessary following activities associated with fire suppression, and it is important that wetland fringing vegetation be re-established in degraded areas around the lake to reinforce the buffer between the lake and nearby housing, thus decreasing the chance of potential problems with midges.

CALM's *Policy Statement No. 10 - Rehabilitation of Disturbed Land* (CALM 1986a) provides guidelines for the rehabilitation of lands managed by the Department based on the following principles:

1. Land should be managed as far as possible to avoid disturbance.
2. Rehabilitation should be the last option in a series of management decisions designed to protect environmental values.
3. Rehabilitation should aim to restore original values and help to enhance all potential uses provided the priority uses are not adversely affected.

The Swan Coastal District will prepare a Rehabilitation Plan for the planning area that will outline rehabilitation priorities and the strategic removal of weeds and subsequent replacement with indigenous species. Where possible, plant material or seed used in rehabilitation works should originate from within the reserve or the nearest viable seed source, in order to conserve the genetic integrity of the vegetation communities. It is important that mulch and soil used in rehabilitation works does not contain unwanted weed seeds, pollutants or pathogens (such as *Phytophthora* spp). Seed collection from within the planning area will generally only be permitted for rehabilitation projects within, or directly impacting upon the area.

Community involvement and assistance is encouraged by CALM and always welcome as part of rehabilitation projects (see Working with the Community).

## **PART G INVOLVING THE COMMUNITY**

### **INFORMATION, EDUCATION AND INTERPRETATION**

Forrestdale Lake provides a valuable opportunity to improve community awareness about wetland ecosystems and the values of Ramsar listed wetlands, as well as TECs and DRF species. An effective information, education and interpretation program is vital to achieve the vision and objectives of maintaining, enhancing and communicating reserve values. The program should concentrate on raising awareness about the area's conservation values, the Ramsar convention, potential human impacts, and the positive action visitors can take to support management of Forrestdale Lake and other wetlands.

An Interpretation Plan will be prepared for the planning area to guide the development and implementation of interpretation facilities. Existing interpretation facilities at Forrestdale Lake are limited and will be upgraded in accordance with the proposed interpretation plan.

The interpretation plan will focus on the provision of interpretation signs, ensuring any new signs incorporate the Ramsar logo and an explanation of Ramsar wetlands, waterbirds, and priority, rare and threatened flora, fauna and ecological communities. Once the boardwalk has been replaced, new interpretation signs will be developed and installed along it, and the existing information shelter, located at the end of Moore Street (Map 3), will be upgraded. Given the importance of the site as waterbird habitat, high priority will be given to upgrading the signs for public interpretation and education, thus assisting in achieving conservation objectives. This will be done in consultation with the community, including the local Aboriginal community.

An information brochure on Forrestdale Lake does exist. However it is now out of print. It is recommended that, in consultation with the Friends of Forrestdale, the brochure be updated and reprinted.

#### **Education**

Forrestdale Lake Nature Reserve provides an array of opportunities for education, and is popular with school and community groups, particularly with relation to learning about wetland ecology, as well as flora and fauna and Indigenous heritage. The proposed interpretation plan for Forrestdale Lake will consider opportunities for education.

### **WORKING WITH THE COMMUNITY**

Community involvement is an integral component of CALM's operations. Community groups and individuals are encouraged to be involved in the management of Forrestdale Lake.

The community were involved in preparing this management plan by providing written comments on issues within the planning area, through participation in a community meeting and via written submissions to the draft management plan. In particular, the Forrestdale Lake Nature Reserve Community Advisory Committee has advised the planning team throughout the preparation of this plan.

Ongoing community support is essential for the successful implementation of this management plan. CALM has a formal policy and administrative framework for volunteer activities (*Policy Statement No. 32 - Volunteers*), which includes initiatives to provide more volunteer opportunities, and to provide training to volunteers and to CALM staff in their management of volunteers. Volunteer activities are encouraged and supported at Forrestdale Lake, and community groups, schools, universities and the like will be encouraged to take part in volunteer activities such as waterbird surveys, water monitoring, rehabilitation, and interpretation and education. Furthermore, the local Aboriginal community are welcome to be involved in the implementation of this plan.

#### **Friends of Forrestdale**

The Friends of Forrestdale is a community group dedicated to conserving Forrestdale Lake Nature Reserve and adjoining reserves. The group was launched in 1990 following a recommendation in the Forrestdale Lake Nature Reserve Management Plan (1987) to enable interested volunteers to become involved in rehabilitation and weed control works. They have, to date, played an active and much valued role in the planning and management of the reserve.

## **PART H MONITORING AND IMPLEMENTING THE PLAN**

The planning area is within CALM's Swan Coastal District, which is responsible for the day-to-day management of the area. As such, they are primarily responsible for implementing the plan. The strategies outlined in this plan will be built into the District's works program for the planning area, which outlines the management actions to be undertaken and is updated every three years. The Friends of Forrestdale are consulted with regards to works priorities.

The Conservation Commission will assess the effectiveness of this management plan via regular audits. Progress against Key Performance Indicators will be assessed by the Commission in periodic audits of the plan, or as it otherwise deemed necessary.

#### **TERM OF THE PLAN**

In accordance with the CALM Act, the term of this management plan is for a period of 10 years from the date the plan is gazetted. At the end of the 10-year period, the management plan may be reviewed with full public consultation and re-submitted by the Conservation Commission to the Minister for the Environment for approval. The CALM Act also specifies that in the event of such a revision not occurring by the end of the management plan's specified life-span, the plan will remain in force in its original form, unless it is either revoked by the Minister or a new plan is approved.

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**FORRESTDALE LAKE NATURE RESERVE: MANAGEMENT SUMMARY**

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
<b>LAND TENURE</b>				
<p><b>PLANNING AREA AND TENURE</b></p> <ul style="list-style-type: none"> <li>• Negotiations are continuing between CALM and the City of Armadale regarding the transfer of the adjoining recreation reserve, excluding the golf course, to the Conservation Commission of Western Australia (Conservation Commission).</li> <li>• The Western Australian Planning Commission (WAPC) has purchased lands adjacent to Forrestdale Lake. CALM will liaise with the Department for Planning and Infrastructure to pursue the transfer of this land for inclusion in the nature reserve and vesting in the Conservation Commission.</li> <li>• There are a number of unnecessary road reserves within the planning area that will be closed and added to the nature reserve.</li> </ul>	<p><b>OBJECTIVE</b> To ensure all lands that comprise the planning area are created as nature reserves and transferred to the Conservation Commission of Western Australia, for management by CALM.</p> <p><b>THIS WILL BE ACHIEVED BY:</b></p> <ol style="list-style-type: none"> <li>1. Continuing negotiations with the City of Armadale to transfer the vesting of Recreation Reserve 27165 (excluding the Armadale Golf Course) to the Conservation Commission, as nature reserve. [HIGH]</li> <li>2. In conjunction with the Department for Planning and Infrastructure, pursuing the transfer of adjacent land to the south-east and Bush Forever site 345, to the Conservation Commission as nature reserve, as they become available. [HIGH]</li> </ol>	Changes in land tenure and purpose.	To formally change the land tenure and purpose of the proposed additions to nature reserve (Class A) within two years of release of the management plan.	After two years or once changes in land tenure and purpose occur.

**FORRESTDALE LAKE NATURE RESERVE: MANAGEMENT SUMMARY**

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
<b>LAND TENURE (CONTINUED)</b>				
	3. Transferring the land that is the existing golf course to the Conservation Commission as nature reserve, when the City of Armadale no longer uses the course. [MEDIUM] 4. In conjunction with the Department for Planning and Infrastructure and the City of Armadale, closing the unnecessary road reserves within the planning area for addition to the nature reserve. [MEDIUM]			
<b>MANAGING THE NATURAL ENVIRONMENT</b>				
<b>WETLAND AND CATCHMENT MANAGEMENT</b> <b>Managing Water Levels</b> <ul style="list-style-type: none"> <li>Forrestdale Lake is a surface expression of groundwater that has formed where the water table intersects with the ground surface. Therefore, the lake's water levels are directly affected by management of the regional groundwater system, and by climate.</li> </ul>	<b>OBJECTIVE</b> To maintain a water level regime that supports the lake's water-dependent ecosystems and meets the needs of the range of waterbirds that use the lake.			

<ul style="list-style-type: none"> <li>• Groundwater, and subsequently, wetland levels on the Jandakot Groundwater Mound have generally been decreasing since the 1970s due to a combination of dry climate and ground water abstraction.</li> <li>• While the lake is naturally subject to seasonal drying over summer, this is exacerbated in periods of drier climate where it dries out earlier in the season.</li> <li>• Continued low water levels have resulted in the encroachment of <i>T. orientalis</i> onto Forrestdale Lake, which has reduced the waterbird habitat value of the lake.</li> <li>• A positive consequence of the drier climate has been the elimination of the midge problems of previous wetter years when nutrient enrichment was higher.</li> <li>• The Department of Environment is responsible for monitoring both the surface and groundwater levels of Forrestdale Lake, as part of the environmental conditions on the management of the Jandakot Mound.</li> </ul>	<p><b>THIS WILL BE ACHIEVED BY:</b></p> <ol style="list-style-type: none"> <li>1. Liaising with the Department of Environment regarding the monitoring and maintenance of appropriate water levels in the lake. [HIGH]</li> <li>2. Liaising with the Department of Environment and the Department for Planning and Infrastructure to ensure that proposed developments in the catchment of the planning area consider groundwater allocation limits that have been set for the relevant groundwater area. [HIGH]</li> <li>3. Arranging an annual forum with the Department of Environment and the Water Corporation to exchange information relating to water management issues at Forrestdale Lake. [MEDIUM]</li> </ol>	<p>Changes in ecological values and waterbird habitat as a result of management of the groundwater.</p>	<p>To be determined, subject to the results of the Section 46 review of Environmental Water Provisions on the Jandakot Groundwater Mound, and once the revised conditions have been set for Forrestdale Lake.</p>	<p>Every three years. If the target is not achieved, the Conservation Commission will liaise with the Department of Environment.</p>
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**FORRESTDALE LAKE NATURE RESERVE: MANAGEMENT SUMMARY**

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
<b>MANAGING THE NATURAL ENVIRONMENT (CONTINUED)</b>				
<p><b>WETLAND AND CATCHMENT MANAGEMENT</b></p> <p><b>Managing Water Quality</b></p> <ul style="list-style-type: none"> <li>• Water quality and indicators of wetland health, such as macroinvertebrates, have been the subject of numerous studies at Forrestdale Lake since 1989.</li> <li>• A number of factors influence the water quality of Forrestdale Lake, particularly groundwater discharge containing runoff from surrounding rural and urban land uses.</li> <li>• CALM, with the assistance of the Friends of Forrestdale, monitors the water quality of the lake on an annual basis.</li> <li>• The lake has a history of poor water quality and of being very enriched.</li> </ul>	<p><b>OBJECTIVE</b></p> <p>To maintain a healthy aquatic ecosystem, thereby ensuring the provision of a feeding ground and refuge for waterbirds and protection of the reserve's ecological values.</p> <p><b>THIS WILL BE ACHIEVED BY:</b></p> <ol style="list-style-type: none"> <li>1. In co-operation with DoE, continuing to undertake a water-sampling program to monitor nutrient levels and water quality. [HIGH]</li> <li>2. Supporting the Department of Environment and the City of Armadale regarding the formation and implementation of an Integrated Catchment Management group and an Integrated Catchment Management Plan for the Forrestdale Lake catchment. [HIGH]</li> </ol>	<p>Changes in richness, relative abundance and community composition of naturally occurring aquatic macroinvertebrate populations.</p>	<p>Subject to natural variation<sup>1</sup>, no decline in the richness of the aquatic macroinvertebrate community from the recent records described in the monitoring report provided by Wild and Davis (2004) to the DoE<sup>2</sup>.</p>	<p>Every three years.</p>

<ul style="list-style-type: none"> <li>• Concentrations of total phosphorus above 150 mg/L are usually associated with poor water quality and nuisance midge swarms.</li> <li>• Nuisance swarms of non-biting midges (Chironomids) are an indicator of poor water lake. Densities of larval midges that reflect high levels (i.e. in excess of 2000 larvae/m<sup>2</sup>) are considered to occur as a result of algal food source, which, in turn, is a response to enrichment.</li> <li>• The current dry climate phase (in which the lake dries completely over late summer and autumn) is thought to result in a reduction in phosphorous levels in the surface waters of the lake (by a number of processes).</li> <li>• The appropriate management of adjoining land is of major importance for the protection of Forrestdale Lake. As such, catchment management initiatives need to be established for the catchment of Forrestdale Lake.</li> </ul>	<ol style="list-style-type: none"> <li>3. Ensuring any new development proposals within the groundwater catchment are assessed to ameliorate impacts on Forrestdale Lake. [HIGH]</li> <li>4. Liaising with the Water Corporation to pursue the issue of sewerage the Forrestdale Township to reduce nutrients leaching into Forrestdale Lake. [HIGH]</li> <li>5. Working cooperatively with state and local government authorities regarding the management of surface and subsurface drainage. [MEDIUM]</li> </ol>	Concentrations of total P in the water column.	Maximum concentration of total P < 150 micrograms/L.	Every three years.
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<sup>1</sup> The natural variations referred to will be as advised by CALM Science.

<sup>2</sup> This report documents richness recorded on an annual basis since 1996 (and at less frequent intervals from 1989).

**FORRESTDALE LAKE NATURE RESERVE: MANAGEMENT SUMMARY**

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
<b>MANAGING THE NATURAL ENVIRONMENT (CONTINUED)</b>				
<p><b>NATIVE PLANTS AND PLANT COMMUNITIES</b></p> <ul style="list-style-type: none"> <li>The planning area supports 252 native plant species, which comprise six regional floristic groups of the Swan Coastal Plain (two of which are TECs), two DRF and five Priority flora species.</li> <li>Vegetation communities in the planning area are representative of those once widespread on the Swan Coastal Plain that have now been significantly cleared.</li> <li>The main threats to the vegetation are environmental weeds, declining water levels, <i>Phytophthora</i> dieback, horse riding and frequent fire.</li> </ul>	<p><b>OBJECTIVE</b> To conserve indigenous plant species and communities, particularly threatened or priority species and TECs.</p> <p><b>THIS WILL BE ACHIEVED BY:</b></p> <ol style="list-style-type: none"> <li>Identifying and conserving vegetation communities and flora species that are rare, threatened or in need of special consideration. [HIGH]</li> <li>Preparing and implementing a Weed Control Plan and a Rehabilitation Plan for the planning area. [HIGH]</li> <li>Reducing the risk of introducing and spreading <i>Phytophthora cinnamomi</i>. [HIGH]</li> <li>Providing information to visitors about the importance of the reserve's vegetation and potential human impacts on this. [MEDIUM]</li> </ol>	Change in the abundance of Priority species.	Subject to natural variation, maintain or increase the number of viable populations of Priority flora species and the number of individuals within the population.	Every three years.





<p><b>ENVIRONMENTAL WEEDS</b></p> <ul style="list-style-type: none"> <li>• 99 weed species have been identified within the planning area. As rated in the <i>Environmental Weed Strategy for Western Australia</i>, according to their impacts on biodiversity, there are 14 high, 52 moderate, 13 mild, 17 low and three that are either unlisted or not rated.</li> <li>• <i>T. orientalis</i> has the potential to further reduce the area of mudflats and invade the emergent native vegetation at Forrestdale Lake and hence is a major management issue.</li> <li>• Other weed species threatening reserve values include arum lily, pampas grass and bridal creeper.</li> </ul>	<p>4. Where appropriate, removing sedges and rushes on mudflats, including <i>Typha</i>, to maintain suitable habitat for migratory waders. [HIGH]</p> <p>5. Protecting native fauna from introduced predators through appropriate control regimes where possible. [HIGH]</p> <p>6. Seeking to maintain wildlife corridor links with nearby conservation areas. [MEDIUM]</p> <p><b>OBJECTIVE</b> To prevent species loss and community decline from weed invasion.</p> <p><b>THIS WILL BE ACHIEVED BY:</b></p> <ol style="list-style-type: none"> <li>1. Preparing and implementing a Weed Control Plan for the planning area. [HIGH]</li> <li>2. Controlling the spread of <i>T. orientalis</i>, and removing it from the lakebed where it is detrimental to migratory wader habitat. [HIGH]</li> <li>3. Monitoring for, and eradicating, new populations of weeds rated as High in the <i>Environmental Weed Strategy for Western Australia</i>. [HIGH]</li> <li>4. Encouraging and supporting the community in undertaking weed control works in the planning area. [HIGH]</li> <li>5. Controlling <i>T. orientalis</i> infestations in parts of James Swamp that lie within the planning area. [LOW]</li> </ol>	<p>Change in the total area of <i>T. orientalis</i> within the reserve.</p> <p>Changes in abundance and distribution of priority environmental weeds (to be determined in the Weed Control Plan).</p> <p>Change in the total area of <i>T. orientalis</i> within the reserve.</p>	<p>A decrease of at least 3% in the total area of <i>T. orientalis</i> from 2004 levels each report period (three years) over the next ten years.</p> <p>No increase in the abundance and distribution of priority environmental weeds from 2004 levels.</p> <p>A decrease of at least 3% in the total area of <i>T. orientalis</i> from 2004 levels each report period (3 years) over the next ten years.</p>	<p>Every three years.</p> <p>Every five years.</p> <p>Every three years.</p>
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**FORRESTDALE LAKE NATURE RESERVE: MANAGEMENT SUMMARY**

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
<b>MANAGING THE NATURAL ENVIRONMENT (CONTINUED)</b>				
<p><b>INTRODUCED AND OTHER PROBLEM ANIMALS</b></p> <ul style="list-style-type: none"> <li>• Problem animals that have been recorded within the planning area include foxes, feral cats, feral honeybees and rabbits.</li> <li>• Midges (Chironomids) inhabit the wetlands of the Swan Coastal Plain, and have been the subject of complaints by local residents at Forrestdale Lake for many years.</li> <li>• Midges have not been a problem in recent dry years however as nutrient enrichment has not been occurring in the lake.</li> <li>• Midge control at Forrestdale Lake is the joint responsibility of CALM and the City of Armadale.</li> <li>• A Pest Animal Control Plan is currently being prepared by CALM that is relevant to reserves of the Swan Coastal Plain, and which will guide pest animal control at Forrestdale Lake.</li> </ul>	<p><b>OBJECTIVES</b></p> <ol style="list-style-type: none"> <li>1. To prevent, and where possible, negate the impact of introduced and other problem animals on the values of the planning area.</li> <li>2. In cooperation with the City of Armadale, to minimise the effect of midge populations, in a manner that has minimal environmental and social impacts.</li> </ol> <p><b>THIS WILL BE ACHIEVED BY:</b></p> <ol style="list-style-type: none"> <li>1. Implementing measures where practical to control introduced species within the planning area where their impacts on ecological values are found to be significant, as per the Pest Animal Control Plan. [HIGH]</li> </ol>			

<p><b>DISEASE</b></p> <ul style="list-style-type: none"> <li>• <i>P. cinnamomi</i> is the most significant pathogen threatening native plants and fauna habitats of the planning area. At present, it is only known to occur on the eastern side of the nature reserve.</li> <li>• The adjoining recreation reserve has not fully been assessed for <i>P. cinnamomi</i>. Only access tracks had been at the time of writing this plan.</li> <li>• Management of <i>P. cinnamomi</i> within the planning area will focus on constraining the human-assisted establishment of new infestations.</li> </ul>	<ol style="list-style-type: none"> <li>2. Undertaking treatment of the lake as necessary to alleviate midge problems, in conjunction with the City of Armadale, and monitoring lake levels, weather conditions and waterbird and macroinvertebrate populations before, during and after treatments. [HIGH]</li> <li>3. Ensuring existing vegetation buffers are maintained, both around the lake and around urban developments adjoining the reserve. [HIGH]</li> <li>4. Annually updating the stakeholder contact list for notification of midge treatments. [MEDIUM]</li> </ol> <p><b>OBJECTIVE</b> To prevent further human-assisted occurrences or spread of <i>Phytophthora cinnamomi</i>.</p> <p><b>THIS WILL BE ACHIEVED BY:</b></p> <ol style="list-style-type: none"> <li>1. Preparing a Dieback Management Plan for the planning area.</li> <li>2. Re-surveying the planning area for <i>P. cinnamomi</i> infection at least every three years, and quarantining affected areas. [HIGH]</li> <li>3. Reducing the risk of introducing and spreading the disease to uninfected areas by limiting access to affected areas, and ensuring appropriate hygiene standards to machinery and vehicles when undertaking works within the planning area. [HIGH]</li> <li>4. Ensuring soils and other materials brought into the planning area are free of <i>P. cinnamomi</i>. [HIGH]</li> </ol>	<p>Changes in the occurrence of <i>Phytophthora cinnamomi</i> infections in the planning area.</p>	<p>No new human-assisted occurrences or spread of <i>Phytophthora cinnamomi</i> in the planning area over the next ten years.</p>	<p>Every three years.</p>
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**FORRESTDALE LAKE NATURE RESERVE: MANAGEMENT SUMMARY**

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
<b>MANAGING THE NATURAL ENVIRONMENT (CONTINUED)</b>				
<p><b>FIRE</b></p> <ul style="list-style-type: none"> <li>• Unplanned fire is a significant threat to the natural and cultural values of the planning area.</li> <li>• Fire management at Forrestdale Lake is guided by CALM's <i>Policy Statement 19 - Fire Management</i>.</li> <li>• CALM, in consultation with FESA and the City of Armadale have prepared a Fire Management Plan to guide fire management within the planning area.</li> <li>• Fire suppression in the reserve is the responsibility of FESA, whilst CALM is responsible for pre and post-suppression works.</li> </ul>	<p><b>OBJECTIVE</b></p> <p>To protect the biodiversity of the planning area, as well as people and property, by minimising the impact of unplanned fire.</p> <p><b>THIS WILL BE ACHIEVED BY:</b></p> <ol style="list-style-type: none"> <li>1. Implementing the Fire Management Plan for Forrestdale Lake. [HIGH]</li> <li>2. Liaising with FESA and the City of Armadale when reviewing the fire management plan for the planning area. [HIGH]</li> </ol>			

<ul style="list-style-type: none"> <li>• Large infestations of introduced bulrush are fire hazards, as fires in such vegetation are difficult to control and can cause damage to fringing vegetation.</li> <li>• Previous unplanned fires in the reserve have contributed substantially to degradation of vegetation and invasion of environmental weeds.</li> </ul>	<ol style="list-style-type: none"> <li>3. Maintaining a system of firebreaks throughout the planning area as per the Fire Management Plan. [HIGH]</li> <li>4. Initiating pre and post suppression works to minimise the spread of plant diseases and weeds in the planning area. [HIGH]</li> <li>5. Isolating stands of <i>T. orientalis</i> for fire protection purposes by cutting into blocks, and slashing, burning or removing blocks where appropriate. [MEDIUM]</li> </ol>			
<b>MANAGING CULTURAL HERITAGE</b>				
<p><b>INDIGENOUS AND NON-INDIGENOUS HERITAGE</b></p> <ul style="list-style-type: none"> <li>• Forrestdale Lake, and the protection of its Indigenous heritage, is important to the local Aboriginal people. The planning area contains one site registered under the <i>Aboriginal Heritage Act 1972</i> and is covered by one registered native title claim.</li> </ul>	<p><b>OBJECTIVE</b> To protect the cultural heritage of the planning area.</p> <p><b>THIS WILL BE ACHIEVED BY:</b></p> <ol style="list-style-type: none"> <li>1. Ensuring management obligations are fulfilled according to the <i>Aboriginal Heritage Act 1972</i> and the <i>Native Title Act 1993</i> prior to any planning or public works being undertaken at Forrestdale Lake. [HIGH]</li> <li>2. Seeking the involvement of the local Aboriginal community in the management of the planning area. [HIGH]</li> </ol>			

**FORRESTDALE LAKE NATURE RESERVE: MANAGEMENT SUMMARY**

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
<b>MANAGING VISITORS</b>				
<p><b>VISITOR USE AND OPPORTUNITIES</b></p> <ul style="list-style-type: none"> <li>Forrestdale Lake is a valuable place for the local community to undertake nature appreciation and passive recreation.</li> <li>The most popular visitor uses within the planning area are birdwatching and walking.</li> <li>Horse riding is an historical use and will be allowed to continue, for local riders only, subject to review over the life of the plan in light of environmental impacts, the demand for the activity and conflicts of use with other visitors.</li> <li>Horse riding occurs on an ad-hoc network of trails in the municipal reserve, and on a bridle trail on the perimeter of the nature reserve.</li> </ul>	<p><b>OBJECTIVE</b></p> <p>To provide for passive, low-impact visitor uses in a manner that is consistent with the purpose and values of the planning area, and which minimises conflict between visitors.</p> <p><b>THIS WILL BE ACHIEVED BY:</b></p> <ol style="list-style-type: none"> <li>Continuing to provide opportunities for bushwalking and birdwatching. [HIGH]</li> <li>Reconstructing the boardwalk using appropriate design and construction method, developed in consultation with the community. [HIGH]</li> <li>Ensuring that horse riding occurs only on the network of fenced bridle trails throughout the planning area, as outlined in Map 3, to minimise both the spread of dieback and impacts on DRF and TECs, and reviewing the appropriateness of the activity at Forrestdale Lake over the life of the plan. [HIGH]</li> </ol>			

**VISITOR ACCESS**

- Access within the planning area is provided on designated trails for a limited number of recreational pursuits as well as for management and emergency vehicles.
- Boat access on the lake is only permitted for management and scientific research purposes.
- Current access for pedestrians is limited, and the trails are relatively unmarked and often inaccessible in winter.
- Pedestrian access will be formalised and sign posted using existing firebreaks and management tracks.
- Where possible, trails within the planning area will be linked with existing and future local trails, and the trail system of nearby Jandakot Regional Park.

4. Upgrading the wet, low-lying section of bridle trail on the southern boundary between the nature reserve and recreation reserve, with blue metal powder or similar, to minimise dieback risk. [HIGH]
5. Monitoring bushland condition in the planning area to ensure horse riding is not contributing to degradation or dieback spread. [HIGH]
6. Prohibiting domestic animals from the nature reserve. [HIGH]

**OBJECTIVE**

To provide safe and convenient access for visitors and management that is consistent with the values of the planning area.

**THIS WILL BE ACHIEVED BY:**

1. Allowing for emergency response within the planning area and ensuring all paths enable access by emergency vehicles. [HIGH]
2. Restricting access by horse riders to designated bridle trails only, and fencing the existing bridle trail along the currently unfenced edge adjoining reserve 27165. [HIGH]
3. Prohibiting the use of recreational watercraft (including model boats) on the lake, and allowing use of watercraft only for education, research and managerial purposes by approved users. [HIGH]

**FORRESTDALE LAKE NATURE RESERVE: MANAGEMENT SUMMARY**

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
<b>MANAGING VISITORS (CONTINUED)</b>				
	4. Upgrading the trails as necessary and installing directional and interpretation signs. [HIGH] 5. Installing cavalettis at trail entrances to enable access by horse riders to designated trails whilst excluding trail bikes and off road vehicles. [MEDIUM]			
<b>MANAGING SUSTAINABLE RESOURCE USE</b>				
<b>SCIENTIFIC RESEARCH AND USE</b> <ul style="list-style-type: none"> <li>Comprehensive studies of the planning area should assess water quality and levels of the lake, groundwater interaction, waterbirds, macroinvertebrates and terrestrial and wetland flora and fauna.</li> </ul>	<b>OBJECTIVES</b> <ol style="list-style-type: none"> <li>To increase knowledge and understanding of flora, fauna and natural processes to provide for better management of the reserve and to monitor the success or otherwise of this management plan.</li> <li>To support and promote external research that will assist in the implementation of the management plan.</li> </ol>			

#### REHABILITATION

- Degradation and loss of natural vegetation has occurred at Forrestdale Lake as a result of frequent wildfire, pest plants and animals, rubbish dumping, uncontrolled access, horse riding and impacts from adjoining land uses.
- There has been an ongoing rehabilitation program in the planning area undertaken by CALM with the support of the Friends of Forrestdale.
- Only local native species should be used for rehabilitation purposes.

#### THIS WILL BE ACHIEVED BY:

1. Prioritising research according to Departmental priorities, Government initiatives and performance assessment for this management plan. [HIGH]
2. Encouraging the participation of volunteers, educational institutions and other organisations to undertake research within the reserve. [HIGH]
3. Encouraging and supporting the Friends of Forrestdale in continuing to undertake regular monitoring of waterbird populations at Forrestdale Lake as part of the Birds Australia program. [HIGH]
4. Supporting, and where possible, seeking grant applications to encourage scientific research and monitoring within the reserve. [MEDIUM]

#### OBJECTIVE

To encourage the natural regeneration of indigenous vegetation, and to restore degraded areas to a condition resembling the natural environment.

#### THIS WILL BE ACHIEVED BY:

1. Preparing and implementing a Rehabilitation Plan for Forrestdale Lake. [HIGH]
2. Using only plants that have been propagated from seeds and cuttings collected either from within the reserve or from provenance from the Swan Coastal Plain. [HIGH]

**FORRESTDALE LAKE NATURE RESERVE: MANAGEMENT SUMMARY**

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
<b>MANAGING SUSTAINABLE RESOURCE USE (CONTINUED)</b>				
	3. Encouraging members of the local community, schools and the Friends of Forrestdale to participate in rehabilitation works. [HIGH] 4. Ensuring mulch, soil and plants used in rehabilitation works do not contain unwanted seeds or plant diseases. [HIGH] 5. Co-ordinating rehabilitation works with weed control and fire protection. [MEDIUM]			
<b>INVOLVING THE COMMUNITY</b>				
<b>INFORMATION, EDUCATION AND INTERPRETATION</b> <ul style="list-style-type: none"> <li>Forrestdale Lake provides a valuable opportunity to improve community awareness about wetland ecosystems and Ramsar-listed wetlands.</li> </ul>	<b>OBJECTIVES</b> 1. To increase community awareness, appreciation and understanding of the values of the planning area, and to gain support for management practices. 2. To increase community awareness, appreciation and understanding of Forrestdale Lake's listing as a Ramsar site, and the significance of Ramsar listed wetlands.			

<ul style="list-style-type: none"><li>• It is important for the effective implementation of this management plan that community understanding and support is fostered for the planning area.</li><li>• There is very little information available about Forrestdale Lake's Ramsar listing, and the significance of Ramsar listed wetlands. This will be addressed through the development of an Interpretation Plan for Forrestdale Lake.</li></ul>	<p><b>THIS WILL BE ACHIEVED BY:</b></p> <ol style="list-style-type: none"><li>1. Developing and implementing an Interpretation Plan for the reserve which focuses on:<ul style="list-style-type: none"><li>• Interpretation signs, ensuring any new signs incorporate the Ramsar logo and an explanation of Ramsar wetlands.</li><li>• Waterbirds;</li><li>• Priority, rare and threatened flora, fauna and ecological communities. [HIGH]</li></ul></li><li>2. Providing information to visitors on reserve values and issues such as Ramsar, visitor safety, permitted activities and regulations. [HIGH]</li><li>3. Providing a written annual update on management for local residents, possibly via the local newsletter, the Forrestdale Rag. [MEDIUM]</li></ol>			
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**FORRESTDALE LAKE NATURE RESERVE: MANAGEMENT SUMMARY**

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
<b>INVOLVING THE COMMUNITY (CONTINUED)</b>				
<p><b>WORKING WITH THE COMMUNITY</b></p> <ul style="list-style-type: none"> <li>Community involvement is an integral component of CALM's operations, and community groups and individuals are encouraged to be involved in the management of Forrestdale Lake.</li> <li>Community support is essential for the successful implementation of this management plan.</li> <li>The Friends of Forrestdale have been in existence since 1990, and are dedicated to conserving the values of the planning area.</li> </ul>	<p><b>OBJECTIVE</b> To facilitate effective community involvement in the management of the reserve.</p> <p><b>THIS WILL BE ACHIEVED BY:</b></p> <ol style="list-style-type: none"> <li>Involving the community, particularly the Friends of Forrestdale and Forrestdale Primary School, in the implementation of this management plan. [HIGH]</li> <li>Continuing to encourage, promote and support local volunteers and the Friends of Forrestdale, with essential resources to help them carry out their activities. [HIGH]</li> </ol>	Change in volunteer hours contributed to the management of the planning area.	No decrease in volunteer hours contributed to the management of the planning area from 2004 levels.	Every three years.

60

\*Note: the response to target shortfall for each of the key performance indicators is for the Department to investigate the cause and report to the Conservation Commission for action.







