Thomsons Lake Nature Reserve

Management Plan 2005

Management Plan No. 54

Conservation Commission of Western Australia

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

THOMSONS LAKE NATURE RESERVE

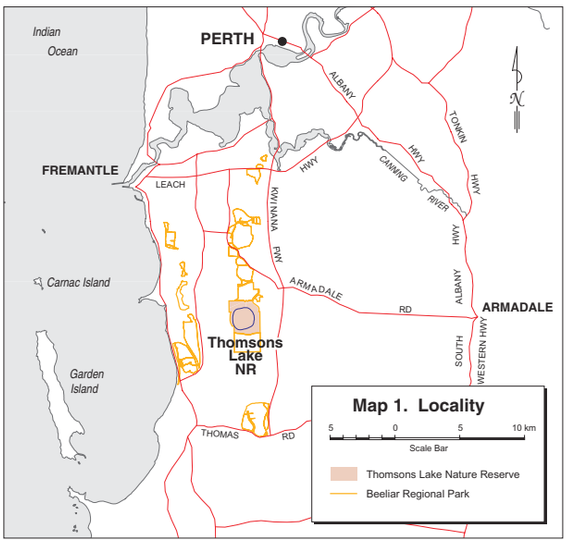
Management Plan 2005

PART A INTRODUCTION

Thomsons Lake Nature Reserve (Thomsons Lake) is a 'Class A' reserve, of 551 ha, gazetted for the purpose of 'Fauna Conservation and Research and Drainage'. Part of Beeliar Regional Park, it is located approximately 34 km south-west of Perth in the City of Cockburn (Map 1).

The reserve is situated on the Swan Coastal Plain in the Swan Coastal Plain bioregion. It is internationally important as a habitat and refuge for water birds, and in 1990, Thomsons Lake, together with Forrestdale 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.

Thomsons Lake, Booragoon Lake and the Spectacles are three wetlands within Beeliar Regional Park that have been listed in the *Directory of Important Wetlands in Australia* (Environment Australia 2001), and, due to the significance of Thomsons Lake for flora and fauna conservation and recreation, it was added to the Register of the National Estate[1] in 1978. In 1997 the entire Regional Park was placed on the Register's Interim List[2]. Furthermore, Thomsons Lake is a Conservation Category Wetland, which is the highest priority for wetland conservation, and is protected under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992.* A revised draft of the policy, the *revised draft Environmental Protection (Swan Coastal Plain Wetlands) Policy 2004,* was in preparation at the time of writing this management plan.



Thomsons Lake is one of 19 wetlands in Beeliar Regional Park and is the largest lake in the regional park's eastern chain of wetlands. Collectively the lakes form one of the most important wetland systems in the Perth metropolitan area. The reserve is part of Bush Forever Site 391 'Thomsons Lake Nature Reserve and Adjacent Bushland, Beeliar', which also includes Kogolup Lake to the north (State of Western Australia 2000). Most areas in Beeliar Regional Park, including Thomsons Lake, are protected under the Metropolitan Region Scheme (MRS) by their Parks and Recreation reservation. The MRS provides the basis for most planning decisions throughout the Perth metropolitan region.

Adjacent land uses at Thomsons Lake include rural living blocks and urban developments to the east and north-west. The reserve, along with remnant vegetation and Conservation Category Wetlands located adjacent to it, form part of a regionally significant contiguous bushland and wetland linkage as part of Beeliar Regional Park (State of Western Australia 2000). Bush Forever site 256 'Yangebup and Little Rush Lakes, Yangebup' is to the north, and site 392 'Harry Waring Marsupial Reserve, Wattleup' is to the south. Both these are also part of the regional park.

In addition to its nature conservation significance, Thomsons Lake is valued by the community as a place for nature appreciation close to urban areas. It also provides significant landscape and amenity value to the region while providing important education and scientific research opportunities.

PLANNING AREA

This management plan incorporates the entire area of Thomsons Lake Nature Reserve. Consideration should be given over the life of the plan to amending the northern portion of the old tramway reserve (north of Wedge Road reserve) from nature reserve to conservation park, as part of overall land tenure changes proposed for Beeliar Regional Park in the *Beeliar Regional Park Draft Management Plan* (CALM 2001).

KEY VALUES

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

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[1] 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.

[2] If a site is registered on the Interim List of the National Estate, it has been publicly proposed for entry in the Register, and the Australian Heritage Commission may be awaiting any objections or seeking other data before making a decision on whether the place should be entered on the Register proper.

The outstanding values of Thomsons Lake are those that contribute to its Ramsar listing. In its joint listing with Forrestdale Lake, Thomsons 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[3];
- 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:

- the importance of the reserve for the protection of threatened and priority flora and fauna species; and
- vegetation communities representative of those once widespread on the Swan Coastal Plain.

Thomsons Lake also has significant cultural values, viz:

- a rich Aboriginal heritage and Aboriginal sites of significance;
- an array of natural and cultural values within close proximity to urban centres that provide significant opportunities for enriching learning experiences.

ECOLOGICAL CHARACTER[4]

Thomsons Lake, together with co-listed Forrestdale Lake, are the best remaining examples of brackish, seasonal lakes with extensive fringing sedgeland typical of the Swan Coastal Plain. In a regional context, they constitute a major breeding, migration stop over and semi-permanent drought refuge area for waterbirds. *Myriophyllum sp.* grows prolifically in the water at Thomsons Lake, whilst *Baumea articulata* and the introduced *Typha orientalis* grow around the edge of the lake. Behind the fringing zone is a belt of *B. juncea* and *B. articulata* with emergent *Viminaria juncea* and *Acacia saligna* shrubs, which gives way to a belt of trees, *Eucalyptus rudis* and *Melaleuca preissiana*, and the shrub *Jacksonia furcellata*. As the ground rises, these are replaced by open woodland dominated by *E. marginata, Banksia menziessii* and *B. attenuata* (CALM 1998).

Within the Swan Coastal Plain, Thomsons Lake is one of the few remaining refuges (in Western Australia) of the threatened Australasian Bittern (*Botaurus poiciloptilus*), is one of few known breeding localities for Baillon's Crake (*Porzana pusilla*), and is the only remaining wetland within the Perth metropolitan area where the Swamp Harrier (*Circus aeruginosus*) still breeds. More than 20 000 waterbirds have been recorded on Thomsons Lake (21 083 in February 1987). Annual data on water depth indicates that conditions at both Thomsons and

[3] See Migratory Waders section in Native Animals and Habitats.

[4] Ecological Character is defined in the Ramsar Convention (Resolution VII.10 of the 7th 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).

Forrestdale Lakes are suitable for use by more than 20 000 waterbirds at least several times within a 25-year period; in the context of wetland availability in Western Australia, this is considered sufficient evidence of regular use by 20 000 waterbirds (CALM 2003a).

Thomsons Lake regularly supports more than 1% of the national population of four shorebirds: Red-capped Plover (*Charadrius ruficapillus*) (up to 1000, February 1986); Black-winged Stilt (*Himantopus himantopus*) (3000, summer 1986); Red-necked Avocet (*Recurvirostra novaehollandiae*) (3000, summer 1986); and Curlew Sandpiper (*Calidris ferruginea*) (2500, March 1983) (CALM 2003a).

PART B MANAGEMENT DIRECTIONS AND PURPOSE

VISION

The vision for Thomsons Lake Nature Reserve is:
To be recognised 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 the flora, fauna and habitats will be managed to a high standard in partnership with the community for its intrinsic values, as a refuge for wildlife and as a safe place to be enjoyed by present and future generations.

INTEGRATED PLANNING

Thomsons Lake is a part of Beeliar Regional Park, which is classed as 'regional open space' comprising land of multiple tenures and reserve purposes, with coordinated management by the Department of Conservation and Land Management (CALM). Planning for regional parks occurs at a number of levels and while the directions for the management of Thomsons Lake are specified in the *Beeliar Regional Park Draft Management Plan* (2001), its Ramsar listing and conservation values require more specific management planning and direction. Hence the development of this area-specific plan that complements the strategies of the *Beeliar Regional Park Draft Management Plan* (2001) and provides specific details for the management of Thomsons Lake.

LEGISLATIVE FRAMEWORK

Legislation and policies

Nature reserves are created under the *Land Administration Act 1997*, vested in the Conservation Commission of Western Australia (Conservation Commission), and managed by CALM. CALM has prepared this management plan in accordance with the legislative specifications of the *Conservation and Land Management Act 1984* (CALM Act). The objective for management plans for nature reserves, as defined in section 56 of the CALM Act, is to: *"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."*

Under the CALM Act, the Department is responsible for administering the *Wildlife Conservation Act 1950* (Wildlife Conservation Act), which provides for the conservation and protection of indigenous flora and fauna on all lands and waters within the State.

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 Thomsons Lake is given additional protection under the EPBC Act. Any action that has, 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 WA'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 Thomsons 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
The Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 protects the environmental values of Thomsons Lake and prohibits any unauthorised filling, mining, draining (into and out of the wetland), effluent discharge and alteration of water levels. The policy affords the protection of the ecosystem health of wetlands on the Swan Coastal Plain, such as Thomsons 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
CALM policies 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 Thomsons 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 Thomsons and Forrestdale 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 Information Sheet for Thomsons and Forrestdale lakes will be available from 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 Thomsons 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, 1979)

The aim of the Bonn Convention is to protect listed species across their entire migratory range. Australia has been a Range State[5] under this Convention 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

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 the management summary table, 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 Conservation Commission will make the results of audits available to the public.

CALM will invite public comment on any proposed amendments to its management of the nature reserve, where they are contrary to this management plan.

[5] 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 Western Australia.

Thomsons Lake is in the Swan Coastal Plain subregion of the Swan Coastal Plain bioregion, a low-lying coastal plain, mainly covered with woodlands, which is dominated by *Banksia* 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 and is 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 management plan, some 15.3% of the Swan Coastal Plain bioregion was vested in the Conservation Commission. It is proposed in the Forest Management Plan (Conservation Commission of Western Australia 2004) that this will increase to 17%, of which 0.04% will be represented in Thomsons Lake.

Thomsons 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 Thomsons Lake are typical of the Swan Coastal Plain. Thomsons Lake is situated in the Perth Basin and occupies a depression between two sand dune systems –the Bassendean system to the east and the younger Spearwood system to the west. The junction of these dune systems is marked by the eastern chain of wetlands of Beeliar Regional Park, of which Thomsons Lake is the largest (CALM 2001).

The two dune systems have occurred as a result of accumulation and subsequent distribution of beach sands of successive shorelines. The major factors influencing their formation are thought to be a series of marine transgressions and prevailing westerly winds.

The soils of Thomsons Lake are considered infertile. The Bassendean sands are highly leached grey quartz sands characterised by excessively

drained ridges and very poorly drained interdunal swales, whereas the Spearwood dunes are younger, less leached and with higher, more rolling relief. The soils are yellow to brown and, within Thomsons Lake, correspond with the soils of the Karrakatta soil/landform unit, described as "undulating landscape with deep yellow sands over limestone" (Crook and Evans 1981).

There are no major threats to the soils or landforms of the nature reserve from active recreation, as such activities are restricted. The presence of the vermin-proof fence also prohibits access by trail bikes, horses and the like. That said, Thomsons Lake is most likely underlain by pyritic peaty sediments, which are potentially acid sulphate soils[6], and has been identified as having high risk of acid sulphate soils, (i.e. less than 3 m from the soil surface) (Swan Catchment Council 2004). This means that extensive digging (e.g. for *Typha* removal), dewatering or drainage has the potential to cause considerable environmental damage if this issue is not considered by management.

WETLAND AND CATCHMENT MANAGEMENT

Hydrology

Thomsons Lake is a surface expression of groundwater, with an area of open water covering approximately 151 ha, or 27% of the total nature reserve, when full. It 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 is dependent on the presence and quality of water, both of which are directly affected by surrounding land use practices and groundwater management.

Wetland ecosystems such as Thomsons Lake are affected by events that cause variations to the quality and quantity of groundwater supply such as rainfall and modified land uses within catchments. In order to protect the wetland ecosystem and the values that contribute to the nature reserve's Ramsar listing and maintain its ecological character, the impacts of existing and proposed land uses need to be understood and managed.

The eastern chain of wetlands of Beeliar Regional Park, which includes Thomsons Lake, is located on the western edge of the Jandakot Groundwater Mound (JGM). There is a complex series of groundwater flows into the wetlands, generally in a westerly direction from the mound.

Management of water resources on the JGM is the responsibility of the Department of Environment (DoE), which, as WA's primary water resources manager, is responsible for the conservation, protection, and management of water resources within and surrounding the reserve. CALM, as the land manager of the reserve, acknowledges that there are processes outside of the reserve that impact on how the lake is managed.

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[6] 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 soil excavation can generate sulphuric acid. Water in contact with the oxidising soil leaches metals from the soil, which then discharges into waterways as acidic water.

Thomsons Lake, along with Kogolup and Yangebup Lakes to the north, is subject to the Southern Lakes Drainage Scheme, which is managed by the Water Corporation. This drainage management scheme controls the maximum water levels of the lake, which is 12.8 AHD, and was developed with the Environment Protection Authority's (EPA) approval, as an environmental condition on the rezoning of land to the east of Thomsons Lake from rural to urban. It diverts stormwater from the suburbs of Success, Atwell, Hammond Park and Banjup away from some of the Beeliar wetlands, in order to minimise changes to their water levels and protect them from nutrient loading.

Managing water levels

Changes in water levels are a significant management issue at Thomsons Lake. Lake water levels respond to events that cause variations to the quantity of groundwater supply, such as rainfall and modified land uses within catchments (including groundwater extraction, urban development and drainage). Groundwater, and subsequently, wetland levels on the JGM, have been under considerable pressure over recent years due to a combination of dry climate, groundwater abstractions reaching management limits, and the influence of drainage on the wetlands (Water and Rivers Commission 2001). To ensure that waterbird habitats are protected at Thomsons Lake, it is important that the lake's water level continues to be monitored, and that management strategies are implemented, where practicable, to maintain suitable water levels.

The water regime at Thomsons Lake is very much influenced by climate. Therefore in wetter years the lake does not tend to dry out, whereas in dryer years, the lake dries out completely in summer and autumn for weeks or months at a time. Seasonal drying is a feature of Thomsons Lake. The drying out of the lake is due to evaporation, and so the duration and time of drying depends on evaporation rates and the amount of water entering the lake over winter and spring.

Long-term groundwater levels, and hence lake water regimes, are controlled by long-term climatic conditions and continually change as the climate does. As the climate of southwestern Australia has become increasingly drier since the 1970s, groundwater levels on the Jandakot Mound have progressively decreased, thereby increasing pressure on groundwater supply. Water levels were much higher at Thomsons Lake in the 1960s and 70s, and have been steadily declining since the 1980s. However, high levels were recorded between 1992 and 1994 as a result of good rainfall in preceding years. Data collected at Thomsons Lake from January 1999 to June 2004 indicates that the water level has fluctuated over the past few years, but has generally been decreasing since 1999 (with the exception of 2000 when the levels were higher again), continuing the current drying trend.

As well as being affected by climate, the water regime at Thomsons Lake is changing due to human activities and impacts (i.e. from surrounding land-uses). As urban development increases in the catchment of the reserve, 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 from the mound, changes in vegetation cover and the increasing presence of impervious surfaces associated with urbanisation.

Declining water levels at Thomsons Lake have become a significant management issue for the protection of the reserve's wetland ecosystem and water bird habitat, including the local cygnet population. In the past, the dry conditions have resulted in a significant number of cygnets perishing inside the vermin-proof fence at Thomsons Lake whilst trying to find an alternative water source once Thomsons Lake had dried up. More water in the lake during November and December would allow the cygnets to mature to a stage where they could fly to another water body in January and/or February.

It is still possible to manage water regimes to support natural ecosystem processes. CALM, in consultation with the Water Corporation and DoE, has initiated a water supplementation trial at Thomsons Lake, to help ensure that water levels remain adequate for the protection of the reserve's Ramsar values and water bird habitat, and to enable the fledgling cygnets to survive at the lake until they are able to fly. The initial trial was undertaken in spring 2004 in accordance with the *Water Supplementation Operational Management Plan for Thomsons Lake Nature Reserve* (CALM 2004). The plan outlines procedures and responsibilities for reviewing water supplementation activities, details water level and water quality monitoring requirements and the timing and duration of supplementation activities, and outlines management procedures and agency responsibilities in relation to maintaining and manipulating drainage infrastructure.

The water supplementation trial involved water being diverted into Thomsons Lake from the Bartram Road Buffer Lake, and included the implementation of environmental controls and an appropriate monitoring regime. At the time of writing this management plan, the supplementation program was being reviewed by CALM and reported on to the Conservation Commission. The review is being based on monitoring results of water quality parameters, water levels, and indicators such as aquatic invertebrates, waterbird observations and the occurrences of botulism (and other causes of waterbird death). If the review indicates that supplementation has had a significant adverse impact on the wetland ecosystem of the reserve (such as elevated nutrient status), it will not be continued. However, should it be determined that the water supplementation program is not having a significant adverse impact on the wetland, CALM will determine the need for its implementation on an annual basis.

In 1992 Environmental Water Provisions (EWPs) were set for a number of wetlands across the JGM, including Thomsons Lake, under Section 46 of the Environmental Protection Act. These EWPs include a preferred minimum water level and an absolute minimum level, and have been set to ensure the lake's habitat value for migratory birds and rare, threatened and priority flora and fauna is maintained. The statutory preferred minimum water level of Thomsons Lake is 11.3 m Australian Height Datum (AHD), with an absolute minimum of 10.8 m AHD.

These Ministerial conditions are currently under review, following breaches at a number of sites across the JGM (although not at Thomsons

Lake). The breaches mainly occurred as a result of water extraction being excessive given the declining water 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 JGM. 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' under Section 46 of the Environmental Protection Act (Water and Rivers Commission 2003).

Within the Section 46 review of environmental conditions on Gnangara and Jandakot Groundwater Mounds, an Environmental Water Requirement's project assessing ecological values and conditions associated with groundwater was undertaken. The outcome of the first stage of the project indicates for Thomsons Lake that the altered hydrology and other storm water drainage disturbances have reduced the 'naturalness' of the wetland.

At the time of writing this plan, stage II 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 Water Corporation is responsible for monitoring surface water levels of Thomsons Lake for the foreseeable future as an environmental condition for the development of the Southern Lakes Drainage Scheme, whilst DoE monitors groundwater levels as part of the environmental conditions on the management of the Gnangara and Jandakot Groundwater Mounds.

Managing water quality

Water quality, along with indicators of wetland health such as macroinvertebrates, has been studied at Thomsons Lake since 1985. A standard biomonitoring protocol has been used since 1989 and up to the present (2004). A number of factors influence the water quality of Thomsons Lake, particularly surrounding land use practices, and the runoff from these into the groundwater, which subsequently enters the lake.

Concentrations of total phosphorus in the lake were measured annually between spring 1996 and summer 2004 as part of a monitoring program undertaken for the Water and Rivers Commission (now DoE) (Wild and Davis 2004). Elevated nutrient levels were recorded, with concentrations exceeding 150 µmg/L on three sampling occasions. Levels above 150 µmg/L are usually associated with poor water quality and nuisance midge swarms (Davis *et al.* 1993). Concentrations recorded in spring 2002 and 2003 were much lower than 150 µmg/L,

probably as a result of the dryer conditions. Continued monitoring of water quality at Thomsons Lake is critical. Collaboration between CALM and the agencies currently responsible for monitoring quality, the Water Corporation (as part of the Southern Lakes Drainage Scheme) and DoE, needs to continue.

The management of water quality at Thomsons 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. The Southern Lakes Drainage Scheme may assist in managing this but the situation needs to be monitored.
(2) The continuation of the current dry phase causing the lake to dry out prematurely. With the current summer drying regime at Thomsons 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 nutrient 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).

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

Many of the ecological problems facing Thomsons 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. Initiatives of integrated catchment management will need to be established for the Thomsons Lake catchment to minimise the effects of water pollution and nutrients entering the wetland system. A comprehensive catchment management plan needs to be prepared for the Thomsons Lake catchment, which integrates town planning and land use considerations with the protection and enhancement of water resources. The agencies involved in this would include the City of Cockburn, DoE and CALM. The catchment management plan should focus on water sensitive urban design measures and an education program targeting the local community and land-holders within the catchment. It should also include environmental water provisions and performance indicators relating to water quality and wetland health.

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). Thomsons Lake is surrounded by a significant buffer of vegetation that aids in maintaining water quality through the filtration and storage of nutrients. It also reduces impacts of problem insects such as midges by providing a physical buffer between the lake and urban areas. The condition of the wetland buffer is also important in mitigating threats. At Thomsons Lake the buffer has been adversely affected by over-grazing by kangaroos (see *Introduced and other Problem Animals*). Wetland fringing vegetation should be re-established in degraded areas around the lake.

NATIVE PLANTS AND PLANT COMMUNITIES

Thomsons Lake supports a diverse range of vegetation communities and flora characteristic of the original dune systems and wetlands of the Swan Coastal Plain. The reserve is located across the Spearwood Dunes, Bassendean Dunes and Bassendean Dunes/Pinjarra Plain landforms, and contains vegetation complexes[7] 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, Karrakatta Complex – Central and South, and Cottesloe Complex – Central and South, on the Spearwood Dunes, and Herdsman Complex, which is characteristic of the wetlands within the Spearwood/Bassendean Dune interface, such as Thomsons Lake (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 sedgelands on the moister sites. Within the vicinity of Perth, it also includes a transition of *E. marginata* to *E. todtiana.*

The Karrakatta Complex – Central and South is predominantly open forest of *E. gomphocephala – E. marginata – E. calophylla* and woodland of *E. marginata* to *Banksia* species, and the Cottesloe Complex – Central and South is a mosaic of *E. gomphocephala* woodland and open forest of *E. gomphocephala – E. marginata – E. calophylla*.

Thomsons Lake itself is characterised by the Herdsman vegetation complex, which is described as sedgelands and fringing woodland of *E. rudis – Melaleuca* species.

On a less broad scale, Gibson *et al*. (1994) classified the vegetation complexes into floristic communities. Four of the 43 floristic community types and subtypes of the southern Swan Coastal Plain are represented in the reserve: Community Type 11 Wet forests and woodlands; Community Type 12 *Melaleuca teretifolia* and/or *Astartea* aff. *fascicularis* shrublands; Community Type 24 Northern Spearwood shrublands and woodlands; and Community Type 28 Spearwood *Banksia attenuata* or *B. attenuata – Eucalyptus* woodlands (State of Western Australia 2000).

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

All native flora in Western Australia is protected under the Wildlife Conservation Act. Protected flora that is likely to become extinct or is rare or otherwise in need of special protection can be declared to be 'rare flora' under section 23F of the Wildlife Conservation Act, and is currently managed in accordance with CALM's proposed *Policy Statement No. 9 – Conserving Threatened Species and Ecological Communities* (subject to final consultation). In addition, species that do not meet criteria for listing as threatened because of insufficient information, species that have been recently removed from the threatened list, or that are near threatened and require monitoring are placed on the Department's Priority Flora list. Species on this list are grouped into Priority categories 1 through to 5.

Keighery (1999) surveyed the vascular flora of Thomsons Lake and identified 491 taxa, including 360 native and 131 introduced species. Thomsons Lake contains 89% of the 406 native taxa identified in Beeliar Regional Park by Keighery (1996). The reserve contains one significant flora species: *Dodonaea hackettiana*, a Priority 4 species[8]. One other species, *Lysinema elegans*, is a significant population endemic to the Swan Coastal Plain and is considered to be poorly reserved (State of Western Australia 2000a).

Threats to plants and plant communities include decreasing water levels (see *Wetland and Catchment Management*), unplanned fire (see *Fire*), weeds (see *Environmental Weeds*) and dieback (see *Diseases*).

NATIVE ANIMALS AND HABITATS

Thomsons Lake is especially significant as a wetland habitat. In total, 135 native bird species have been recorded in the reserve, comprising 66 terrestrial species and 69 species of waterbirds. One introduced species, the mallard duck, has also been recorded at Thomsons Lake (Burbidge and Birds Australia 2002). The lake regularly supports more than 10 000 waterbirds, including 21 species protected under JAMBA and/or CAMBA and 16 migratory species (see *Migratory Waders*).

Thomsons Lake provides habitat for Carnaby's black-cockatoo (*Calyptorhynchus latirostris*), a specially protected species that is listed under the *Wildlife Conservation Act 1950*. The peregrine falcon (*Falco peregrinus*), which is also specially protected, has been recorded in many parts of the metropolitan area and may occur in the nature reserve (Wildlife Conservation (Specially Protected Fauna) Notice 2004). Also, Thomsons Lake is one of the few remaining refuges (in Western Australia) of the threatened Australasian Bittern (*Botaurus poiciloptilus*) (CALM 2003a).

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[8] Priority 4 species are categorised as either Rare, Near Threatened or other species in need of monitoring:

(a) Rare species are those that are considered 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 present circumstances changes. These species are usually represented on conservation lands.

(b) Near threatened species are those 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.

Three 'habitat specialists with a reduced distribution on the Swan Coastal Plain (birds)' and seven 'wide-ranging bird species that have reduced populations on the Swan Coastal Plain' (State of Western Australia 2000) have also been recorded within the reserve.

Surveys for mammal species within the reserve have been limited. However five species of mammal have been recorded at Thomsons Lake: the quenda (*Isoodon obesulus fusciventer*), a Priority 5 species on CALM's Priority Fauna List[9], the western grey kangaroo (*Macropus fuliginosus*), the brush-tailed possum (*Trichosurus vulpecula*), the numbat (*Myrmecobius fasciatus*), listed as Threatened under the Wildlife Conservation Act (although not recorded in the reserve since 1984), and the native water rat (*Hydromys chrysogaster*). The Swan Coastal Plain has nine species of insectivorous bats, some of which are likely to use the reserve for occasional foraging, if not permanently (CALM 2001). Mammal species that once would have occurred at Thomsons Lake include the western brush wallaby (*Macropus irma)* and the quokka (*Setonix* brachyurus). These could potentially be reintroduced into the reserve as part of the kangaroo management program (see *Introduced and Other Problem Animals*).

Seven species of frogs have been recorded in the reserve (Crook and Evans 1981). However, later reports have identified only six species (ANCA 1996). The turtle frog (*Myobatrachus gouldii*), the distribution of which is limited to the southwest corner of Western Australia, may no longer be present.

Twelve lizard species, three species of snake, the little whip-snake (*Denisonia gouldii*), the tiger snake (*Notechis scutatus occidentalis*) and the dugite (*Pseudonaja affinis*), as well as the long-necked tortoise (*Chelodina oblonga*) have been recorded at Thomsons Lake. Several fauna 'underpasses' have been installed under the vermin-proof fence at Thomsons Lake to enable the passage of tortoises in and out of the reserve, and between Thomsons and Kogolup Lakes.

Declining groundwater levels have resulted in Thomsons Lake drying out prematurely over the past few years. This has resulted in cygnets, which have not matured to a stage where they can fly, being trapped inside the vermin-proof fence whilst trying to find an alternative water source at Kogalup Lake. The water supplementation trial should help to alleviate this problem (see *Wetland and Catchment Management*), by diverting stormwater into the lake during winter so that water is present in November and December. This would allow the cygnets to mature to a stage where they can fly to other water bodies as Thomsons Lake dries up.

Should there still be insufficient water in the lake, CALM has put in place a cygnet management plan, whereby the vermin proof fence between Thomsons and Kogalup Lakes will be monitored in spring and early summer. If cygnets are present at the fence, a management gate will be opened, allowing safe passage for the fledgling cygnets to access Kogalup Lake.

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[9] Priority 5 taxa are 'conservation dependent'taxa subject to a specific conservation program, the cessation of which would result in species becoming extinct within five years.

In 1993 a vermin-proof fence was constructed around Thomsons Lake for the protection of native wildlife, by preventing access to the nature reserve by feral animals. Whilst CALM acknowledges that the fence does inhibit the movement of some fauna (eg kangaroos, tortoises and cygnets), the benefits of the fence in protecting migratory waders, other fauna and their habitats, takes precedence. As such, retention of the fence is considered appropriate.

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

Migratory waders

Thomsons Lake is an internationally important wetland, providing habitat for 16 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 and the curlew sandpiper (2500 individuals each), and the sharp-tailed sandpiper (1000 individuals). The next most abundant species are the wood sandpiper (45 individuals) and the common greenshank (40 individuals) (Burbidge and Birds Australia 2002). Other notable species include the long-toed stint (*Calidris subminuta*), which occurs regularly when mudflats become exposed. The highest count of these (20 in February 1991) is at least 1% of the probable national population and one of the criteria for the reserve's Ramsar nomination (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 Thomsons Lake, it is essential that the amount of *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.

Macroinvertebrates

Macroinvertebrates have been the subject of several studies at Thomsons Lake since 1985, and more recently, a monitoring program has been undertaken (between autumn 1996 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 Thomsons Lake. Macroinvertebrates from a total of 40 families were collected from Thomsons Lake over the monitoring period 1996-2004. These included two annelids, two molluscs, nine crustaceans, seven arachnids and twenty insect species. 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 submerged macrophytes in spring 1996 (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.

The research has shown that, in general, species richness has decreased over the period of the monitoring program, due primarily to climatic effects and changes, which, in turn, have affected water levels and therefore, macroinvertebrate habitat (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 for Thomsons Lake during the study period indicate that nutrient enrichment (eutrophication) is an issue of ongoing concern at the lake (Wild and Davis 2004).

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 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 within the reserve, being the focus for weed management (see the management summary table). Further guidance for management is provided by *Policy Statement No. 14 – Weeds on CALM Lands* (CALM 1986), and the proposed *Policy Statement – Environmental Weed Management* (subject to final consultation).

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 both the Environmental Weed Strategy, and the Weed Control and Rehabilitation Plan that is proposed to be developed for Beeliar Regional Park (CALM 2001). Rehabilitation of areas following weed removal is important to prevent re-invasion of weed species (see *Rehabilitation*).

Keighery (1999) identified 131 exotic plant species within Thomsons Lake Nature Reserve. As rated in the Environmental Weed Strategy for Western Australia, there are 15 High impact species, 57 Moderate, 14 Mild, 35 Low, and 10 species that are either unlisted or not rated.

Introduced bulrush (*Typha orientalis*), arum lily (*Zantedeschia aethiopica*) and pampas grass (*Cortaderia selloana*) (all rated High) pose the greatest threat to native vegetation in the reserve. To date, a control program has been implemented to remove pampas grass, arum lily, cape tulip (*Homeria flaccida*) (all rated High), fig (*Ficus carica*) (Moderate), and castor oil plant (*Ricinus communis*) and thistle (*Silybum marianum*) (Low). This is on going to control re-infestations.

Priorities for weed control within the reserve are determined based on the principles and rankings of the statewide weed strategy, as well as their potential impacts on biodiversity at a local level. Also taken into consideration are other local concerns such as ongoing maintenance to limit the return of species previously removed.

The *Beeliar Regional Park Draft Management Plan* (CALM 2001) identifies the presence of weeds as a major problem and a threat to conservation values. Introduced bulrush, an aggressive colonizer in disturbed environments, has the potential to further significantly reduce the area of open water and invade the emergent native vegetation and hence is a major management issue at Thomsons 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 Thomsons Lake, along with couch (*Cynodon dactylon*), buffalo grass (*Stenotaphrum secundatum*) and kikuyu (*Pennisetum clandestinum*) (all rated Moderate), 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. The drains that flow into Thomsons Lake from adjoining land are a major source of weeds in the reserve.

It is important that soil being imported into the reserve (e.g. for landscaping and rehabilitation) is free of both weed seeds and *Phytophthora cinnamomi*.

A proposed Weed Control and Rehabilitation Plan for Beeliar Regional Park will provide further direction for on-going weed control within Thomsons Lake Nature Reserve.

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).

CALM is in the process of developing a control plan for introduced and other problem animals, which will be implemented across a suite of reserves on the Swan Coastal Plain. The control plan will guide the management of pest animals in the regional parks, including Beeliar and, subsequently, Thomsons Lake.

Predation by foxes has, in the past, been identified as a threatening process for the breeding waterbirds and other native fauna within the reserve (Mawson 2002). In 1993 a vermin-proof fence was constructed around Thomsons Lake, to enable a fox eradication program to be implemented within the nature reserve. Since its construction, foxes have been subjected to an ongoing control program within the boundary of the fence, and as a result, are presumed to be present only in very small numbers, if at all. The fox control program will continue to be implemented in the reserve as required.

Feral cats are present in the reserve, and the extent of their impact is currently unknown. The potential of such animals to prey on waterbirds, particularly hatchlings, is a significant concern. Rabbits are also present in the reserve in small numbers. The control of these species will be considered in the Regional Parks Pest Animal Control Plan (CALM in prep.) and will occur in accordance with operational priorities.

The swarming of midges (Chironomids) occurs seasonally at some of the Beeliar wetlands, as a response to high nutrient enrichment and as a symptom of disturbed environments, including poor water quality. However, Thomsons Lake is not currently identified as a problem area due to the large vegetation buffer around the lake and the lack of residential development in close proximity to the reserve (CALM 2001). The large buffer helps to maintain water quality by reducing the influx of nutrients through filtration and storage, and acts as a physical impediment to the movement of midges.

There are a number of problem species present in the nature reserve that might compete with native fauna for nest hollows, such as rainbow lorikeets (*Trichoglossus haematodus*), galahs (*Eolophus roseicapilla*), corellas (both long-billed and little) (*Cacatua tenuirostris* and *C. sanguinea*)[10] and feral bees. These will be controlled when and as necessary in accordance with operational priorities, but at the time of writing this plan, they were not deemed to be a significant problem at Thomsons Lake.

Kangaroos

In some instances native fauna can also have adverse impacts on their environment. Thomsons Lake Nature Reserve has a population of western grey kangaroos (*Macropus fuliginosus*) confined within the vermin-proof fence. Before the fence was constructed, in 1993, it was estimated that the kangaroo population of the reserve was approximately 20-30 animals. A survey in April 2002 by Mawson (2002) counted 141 animals, comprising 67 adult males, 10 juveniles and 64 adult females and sub-adults, which has further increased at the time of writing this plan. This is far in excess of the kangaroo population at the reserve prior to construction of the fence. Consequently, the biodiversity values of the reserve are being significantly affected. Vegetation within the reserve is being overgrazed, habitat is being destroyed, flora values are being diminished and naturally occurring rehabilitation and plant succession is being inhibited. Anecdotal evidence suggests that the number of orchid plants and species have decreased, possibly as a result of over-grazing by kangaroos.

[10] Galahs and corellas (little and long-billed) are native species formerly not found on the Swan Coastal Plain.

CALM, together with the Conservation Commission, considered the public submissions in relation to the management options outlined in the draft management plan, for reducing the impact of kangaroos at Thomsons Lake.

Based on these considerations, the initial management intent is to reduce the population by culling using a licensed professional shooter in accordance with the *Code of Practice for the Humane Shooting of Kangaroos* and under the provisions of a Damage Licence issued by CALM. Kangaroo numbers will be reduced to a preferred population of approximately 22 animals, with a proposed structure of six adult males, 10 adult females and six sub-adult animals. In order to maintain the population at a sustainable level, subsequent on-going culling by shooting will occur as necessary, with culling initiated whenever the population reaches approximately 50 animals. Given the natural reproduction and mortality rates for western grey kangaroos, culling may be necessary and practical every 2-3 years. This control regime should be adequate to enable the vegetation in the reserve to recover. However, if this is not the case, culling may be implemented more frequently for the first few years to enable the vegetation to recover from its current degraded state.

While culling by shooting is considered the most effective method of control, the control method will be subject to review over the life of the management plan. Other options, such as the removal of the entire kangaroo population and replacement with alternative macropod species of higher conservation significance that once inhabited the area, for example the western brush wallaby (*Macropus irma)* and/or the quokka (*Setonix brachyurus*), will be considered.

In undertaking kangaroo management actions CALM will consult with stakeholders through the implementation of a communication strategy.

DISEASE

Disease caused by *Phytophthora*

The most significant disease threat to plants within the reserve is *Phytophthora* 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 that were imported 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, species are eliminated from the site. This could lead to dramatic and permanent changes to native plant communities and their dependent fauna.

The disease is considered to be a significant threat to the entire Beeliar Regional Park, given that the existing upland plant communities contain a number of susceptible species, namely jarrah, banksias and grasstrees. Dieback has been recorded in the southeast section of Thomsons Lake Nature Reserve. 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. Hence, management of *P. cinnamomi* within the reserve 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. As such, barriers preventing vehicle access have been installed on the entire eastern side of the reserve between the northern and southern radial firebreaks. It is equally important to ensure that soil imported into the reserve is free of *P. cinnamomi*.

Maher Brampton Associates (2001) identify horseriding as a potential contributing factor to the introduction and spread of *P. cinnamomi* in Thomsons Lake. However the key issue is that vehicles be restricted from entering the fenced area of the reserve. This includes CALM management vehicles, agencies and organisations undertaking research and monitoring, agencies requiring access to drainage infrastructure, and relevant contractors. Vehicle access into the reserve (with the exception of emergency access) requires written approval from CALM.

Furthermore, significant works that involve disturbing the soil require the preparation of a dieback management plan. Where possible, significant works in the reserve 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*.

Dieback management at Thomsons Lake will occur in accordance with CALM's *Policy Statement 3 – Management of Phytophthora and disease caused by it* (CALM 1998a). It is recommended that a survey for *P. cinnamomi* be undertaken across the entire nature reserve and that ongoing surveys occur as required.

FIRE

Unplanned fire is a significant threat to the natural and cultural values of the reserve. 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 (CALM 2001).

When managing fire at Thomsons Lake, CALM is guided by the *Bush Fires Act 1954* and *Policy Statement 19 – Fire Management* (subject to final consultation). If selected prescribed burning is being considered for the reserve, further consultation will occur with the City of Cockburn and other stakeholders.

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

CALM, in conjunction with the City of Cockburn and FESA, has prepared a *Fire Working Arrangements and Suppression Response Plan for Beeliar Regional Park*, to ensure effective and efficient response to

unplanned fires. The plan is reviewed annually and includes information specific to Thomsons Lake such as values at risk by fire, hazards for firefighters, access points, dispatch requirements, emergency contacts and strategies for fire suppression.

Signs should be installed indicating the location of gates around the reserve, so that visitors are aware of access and egress points in the event of fire (see *Information, Education and Interpretation*).

PART D MANAGING CULTURAL HERITAGE

INDIGENOUS HERITAGE

Research indicates that at the time of colonisation, three Aboriginal communities occupied Perth, one of which was the Beeliar community (Seddon 1972). The wetlands of the eastern and western chain of what is now Beeliar Regional Park, including Thomsons Lake, were part of the Beeliar District, which extended south of the Swan River.

Beeliar Regional Park is significant to the local Aboriginal people, as parts of it were important camping and food source areas (Polglaze 1986). The eastern chain, and hence Thomsons Lake, is said to have been part of a major trade route between Aboriginal people in the Swan and Murray River areas. The lakes of Beeliar Regional Park also hold importance as spiritual and mythological locations, and according to Polglaze (1986), the wetlands "provide an important link to the natural context, cultural traditions, spiritual life and history of the Aboriginal people of the Swan Coastal Plain".

The conservation of indigenous heritage is important in maintaining the identity, health and well being of indigenous people (Australian Heritage Commission 2002). In Western Australia, 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 Aboriginal heritage sites are protected under the Act whether they have been entered on the register or not. A key management issue is to ensure that Aboriginal sites are protected from damage, and that obligations are fulfilled according to the Aboriginal Heritage Act.

Three sites within the nature reserve are listed on the Department of Indigenous Affairs' Register of Aboriginal Sites.

In addition to the Aboriginal Heritage Act, the requirements of the Commonwealth *Native Title Act 1993* (Native Title Act) also need to be fulfilled before any planning or public works occurs.

The reserve is covered by one registered native title claim by the Combined Swan River and Swan Coastal Plains Native Title Claimant Group. According to S24jb(7) of the Native Title Act, native title claimants and their controlling body must be notified of proposed public works to be undertaken and when a new management plan is to be developed.

CALM will liaise with the Aboriginal community during the implementation of this management plan to facilitate their involvement in the management of the reserve and for the protection of cultural sites.

NON-INDIGENOUS HERITAGE

The first colonial settlement of the Cockburn district was in 1830. Initial settlement had little influence on the wetland areas south of the Swan River. However in the late 1800s when the State's population trebled as a result of the goldrushes, market gardens were established on the land surrounding the wetlands. This resulted in vast areas of land being cleared and a once complex network of wetlands drained extensively for agriculture (Drake and Kennealy 1995).

At Thomsons Lake, a proposed grazing lease was rejected in 1954 based on the area's value as habitat for native fauna, and in 1955 the reserve's purpose was changed from 'Drainage' to 'Drainage and Conservation of Fauna'. During this time, and into the 1960s, the as yet unvested reserve was being used by adjoining landholders for cattle grazing and the vegetation was being cut for firewood, with both practices having an impact on the reserve's vegetation (Crook and Evans 1981).

Land was excised from the reserve in 1962 for a prison site and again in 1969 for The University of Western Australia's Marsupial Breeding Station. The development of land around the reserve mainly occurred during the 1960s, and by 1968, most of the private land to the east and southwest had been subdivided (Crook and Evans 1981).

The managing agency at the time, the Department of Fisheries and Fauna, sought vesting of the reserve. This was agreed to on the proviso that the lake could still be used as required for drainage purposes: consequently the reserve was vested in the then WA Wildlife Authority for its current purpose of 'Fauna Conservation and Research and Drainage' (Crook and Evans 1981).

At the time the reserve was transferred to the Wildlife Authority, the lake was used for water skiing. Since then, the nature reserve has become increasingly popular with the local community as a place for nature appreciation, in particular birdwatching and bushwalking.

PART E MANAGING VISITORS

VISITOR OPPORTUNITIES

The location of Thomsons 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 reserve provide opportunities for nature appreciation, bird watching, bushwalking and environmental education.

CALM's *Policy Statement 18 – Recreation, Tourism and Visitor Services* (subject to final consultation) 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 Thomsons 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 Thomsons 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 Thomsons Lake.

Visitor use at Thomsons 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*).

Domestic animals are prohibited in the nature reserve.

Birdwatching

Considering the importance of Thomsons 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. Bush birds within the nature reserve are also valued by birdwatchers.

Bushwalking

Bushwalking is a popular pursuit within Thomsons Lake Nature Reserve. There is a well-established network of firebreaks and management access tracks that are used by bushwalkers. Walking trails that are based on the existing network of firebreaks are illustrated in Map 2. These would benefit from improved trail marking and some interpretation signs, which has been addressed in this management plan (see *Visitor Access* and the management summary table).

Horse riding

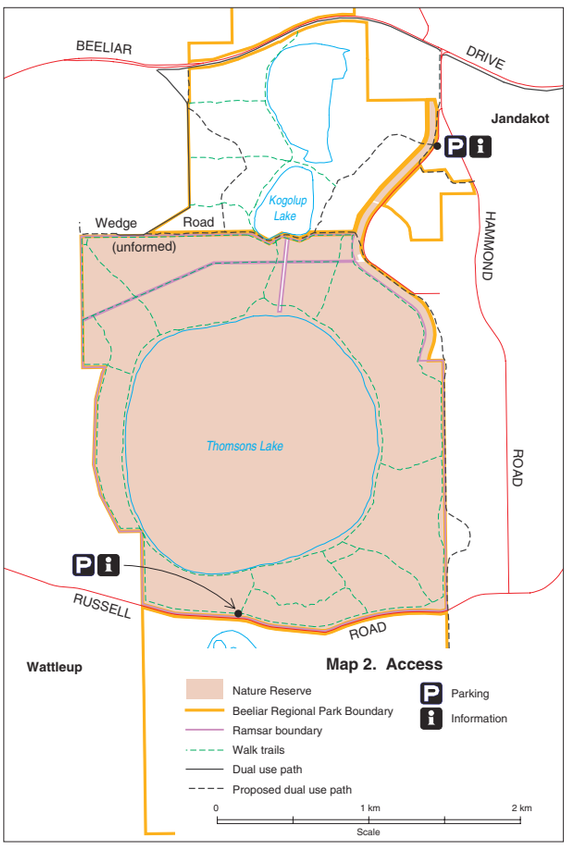
Horse riding is an historical use in the Thomsons Lake area, having being a popular recreation pursuit for at least 40 years. CALM's *Policy Statement 18 Recreation, Tourism and Visitor Services* (subject to final consultation) states that horse riding will generally not be permitted in nature reserves due to the incompatibility of the activity with the purpose of nature reserves. However, the policy states that an activity may be permitted where it has been previously allowed and the impacts of the activity can be minimised and controlled. Horse riding will be allowed to continue outside the vermin-proof fence in the foreseeable future. No floating areas will be provided. The activity will be reviewed over the life of the plan in light of environmental impacts, the demand for horse riding and conflicts of use with other visitors.

No commercial horse riding operations will be permitted in Thomson Lake Nature Reserve. Horse riding will be prohibited by CALM if increased erosion, disease or degradation of vegetation occurs as a result of this activity.

VISITOR ACCESS

Access within Thomsons Lake is provided for a limited number of passive recreational uses, as well as for management and emergency vehicles. Access is largely restricted by the existence of the vermin-proof fence around the reserve. Unauthorised access to the lakebed is prohibited, with boats being only permitted for management and scientific research purposes.

Access and recreation facilities for the reserve are illustrated in Map 2, which identifies walking trails and a new dual-use path on the eastern and northern perimeter of the reserve. The walk trails utilise existing firebreaks and management access tracks, which will be upgraded in sections as required.



Another management aim is to improve access to the reserve on the eastern boundary, as well as provision of access for emergency and management vehicles (Map 2).

While the firebreaks and management access tracks form an informal network of walk trails within the reserve, they currently have little or no directional signs for visitors. Installation of such signs would be valuable to assist visitors with navigation and provide visitor safety, particularly in the event of fire. Directional signs should be installed in accordance with the Sign System for Regional Parks (see *Information, Education and Interpretation*).

Most visitors arrive at the reserve by private vehicles or by walking. The main visitor access to Thomsons Lake is on Russell Road. A second car park and entrance point on Branch Circus is proposed to service both Thomsons and Kogolup Lakes. The City of Cockburn has advised that Russell Road is to be upgraded to a dual carriageway in the future. In light of such an upgrade, appropriate road design measures should be incorporated to allow for safe vehicle access and egress into and out of the car park. In due course, the existing car park will be upgraded and asphalted to appropriate standards.

PART F MANAGING SUSTAINABLE RESOURCE USE

SCIENTIFIC RESEARCH AND USE

Research is included in the purpose for Thomsons Lake Nature Reserve. There are many opportunities for research within the reserve, for which it is an important and valuable site. This includes 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 Thomsons Lake into the macroinvertebrate community structure since 1985, which can be used as an indicator of wetland health (see *Native Animal and Habitats – Macroinwertebrates*). 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 reserve is to be coordinated by CALM, to ensure an integrated approach that avoids duplication and enables prioritising of projects.

PUBLIC UTILITIES AND SERVICES

Drainage and sewerage infrastructure is located at a number of places in the reserve, to which the Water Corporation require access for maintenance and monitoring works. Non-emergency access requires written permission from CALM.

Existing drainage and sewerage infrastructure in the reserve includes the Southern Lakes Drainage Scheme, which is located in the northeast section of the reserve. Infrastructure for this includes the South

Jandakot Branch Drain and Deep Sewer Main, which service the new urban areas in Success, Atwell, Hammond Park and Banjup. As part of the drainage scheme there is a piped connection from the South Jandakot Branch Drain into Thomsons Lake. It is this pipe that is being utilised for the water supplementation trial (see *Managing Water Levels*). There is also a pump station, which is part of the Southern Lakes Drainage Scheme that has been constructed in the northern section of the reserve, to ensure the maximum drainage operational water level at Thomsons Lake of 12.8 m AHD is not breached. The Water Corporation is responsible for managing all infrastructure associated with the Southern Lakes Drainage Scheme.

The Water Corporation also controls an overflow pipe on the north-west side of Thomsons Lake. The pipe is connected to the Thomsons Lake Reservoir that is located immediately to the west of the reserve. As part of its maintenance program, the Water Corporation discharges water into the lake every 3-5 years that is utilised in scouring and overflowing the reservoir. The Water Corporation is currently reviewing the scouring practices at the reservoir with a view to installing a soakage basin similar to that at most of its other reservoir sites. However a need for an emergency overflow will still be required at Thomsons Lake.

A local government stormwater drain, the "Hammond Road Drain", which is managed by the City of Cockburn, is also located on the east side of Thomsons Lake. The drain is designed to discharge overflow water into Thomsons Lake should the Bartram Road Buffer Lakes inflow drain be unable to meet the required capacity of a one-in-one year storm event. Also, there is an underground water main, managed by the Water Corporation, which traverses the northern section of the reserve in an east-west direction, from the Thomsons Lake reservoir.

Future applications for such facilities will be dealt with on a case-by-case basis and, where possible, will be directed outside of the nature reserve.

REHABILITATION

Several areas within Thomsons Lake Nature Reserve require rehabilitation, principally due to disturbance by kangaroos, and also following weed removal, which will be undertaken in the reserve as per the proposed Weed and Rehabilitation Plan for Beeliar Regional Park. Rehabilitation may also be necessary following activities associated with fire suppression. It is important that kangaroo control is implemented (see *Introduced and Other Problem Animals*) prior to any rehabilitation works commencing in order to ensure the survival of the immature plants.

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.

Rehabilitation priorities will be in accordance with the Weed Control and Rehabilitation Plan for Beeliar Regional Park. 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 reserve will generally only be permitted for rehabilitation projects within, or directly impacting upon the reserve. Rehabilitation of areas fringing the lake will be given high priority, as indicated in the *Beeliar Regional Park Draft Management Plan* (CALM 2001).

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

Thomsons Lake provides a valuable opportunity to improve community awareness about wetland ecosystems and the values of Ramsar listed wetlands. 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 reserve's conservation values, the Ramsar Convention, potential human impacts, and the positive action visitors can take to support management of Thomsons Lake and other wetlands.

A Communication Strategy has been prepared for Perth's network of regional parks, including Beeliar Regional Park. The aim of the strategy is to promote the conservation and enjoyment of regional parks. It outlines interpretive themes (messages) for the regional park network, including park specific themes and management messages. Interpretive themes for Beeliar Regional Park are based on the following values:

- Wetlands as corridors for wildlife and people;
- Waterbirds;
- Groundwater – catchment interactions; and
- The role of environment centres.

An Interpretation Plan for Beeliar Regional Park will be prepared to guide the development and implementation of interpretation facilities for specific areas within the park, including Thomsons Lake, with messages that are focused on the above-mentioned themes. The plan will identify opportunities for interpretation signs and facilities, and locations for these within the nature reserve.

Existing interpretation facilities within Thomsons Lake are limited and will be upgraded as part of the Interpretation Plan for Beeliar Regional Park. Given the importance of the site as waterbird habitat,

interpretation at Thomsons Lake will focus on the values of the reserve that contributed to its Ramsar listing. Signs will also need to be installed informing visitors of the location of access gates so they are aware of these in the event of an emergency, such as wildfire (see *Fire*).

Education

Thomsons 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. As per the *Beeliar Regional Park Draft Management Plan* (2001), an interpretation plan will be developed for the regional park, which will include an education component. The Cockburn Wetlands Education Centre also plays an important role in environmental education within the regional park, which includes Thomsons Lake.

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 Thomsons Lake Nature Reserve.

The community were involved in preparing this management plan by providing written comments on issues within the reserve, and written submissions to the draft management plan. In particular, the Beeliar Regional Park Community Advisory Committee has advised the planning team throughout the preparation of this plan. Furthermore, CALM acknowledges the valuable and on-going work of the Wetlands Conservation Society in the planning and management of Thomsons Lake Nature Reserve, and welcomes the input of the Aboriginal community during implementation of this management 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. 15 – Community Involvement (Public Participation and Volunteers)* (CALM 1991a) 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 Thomsons 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. CALM will seek to establish an active Friends Group for Thomsons Lake to facilitate such work.

PART H IMPLEMENTING AND EVALUATING THE PLAN

The strategies outlined in the plan will be built into the works program of CALM's Regional Parks Unit, which is responsible for the day-to-day management of the reserve. Should there be any inconsistencies in the implementation of the Beeliar Regional Park Management Plan and this management plan, operations will occur in accordance with this plan.

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 plan is for a period of 10 years from the date the plan is gazetted. At the end of the 10-year period, the plan may be reviewed with full public consultation and then re-submitted 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 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. Revisions or amendments to the plan are allowed under Section 61 of the CALM Act.

The Conservation Commission may initiate a review of the management plan before the 10-year term expires. Should significant changes to this plan be required, public comment on the proposed amendments will be sought.

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Personal communications

Associate Professor Jenny Davis – School of Environmental Science, Murdoch University.

Dr Stuart Halse – Principal Research Scientist, Department of CALM.

THOMSONS LAKE NATURE RESERVE: MANAGEMENT SUMMARY

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
PART C. MANAGING THE NATURAL ENVIRONMENT				
WETLAND AND CATCHMENT MANAGEMENT **Managing water levels** • Thomsons 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. • Water entering the lake comes mainly from rainfall, via the groundwater flow, and in periods of little rainfall the lake's water level decreases significantly. • Groundwater, and subsequently, wetland levels on the Jandakot Groundwater Mound have generally been decreasing due to a combination of dry climate and groundwater abstraction.	OBJECTIVE To maintain a water level regime that protects the reserve's ecological values and meets the needs of the range of waterbirds that use the lake. This will be achieved by: 1. Reviewing the water supplementation program trialled in 2004, and continuing the program as appropriate, and in accordance with the *Water Supplementation Operational Management Plan for Thomsons Lake Nature Reserve* (CALM 2004a). [HIGH] 2. Liaising with the Department of Environment and the Water Corporation regarding the monitoring of water levels. [HIGH]	To be developed within four years of release of the management plan, in consultation with the Conservation Commission of WA.		

• A water supplementation program was trialled at Thomsons Lake in spring 2004, with the aim of assisting in the maintenance of the reserve's waterbird habitat and ecological values. • Thomsons Lake is subject to the Southern Lakes Drainage Scheme, which controls the maximum water levels of the lake. The Water Corporation is responsible for monitoring the water levels of the lake for the foreseeable future, as an environmental condition of the drainage scheme.	3. Liaising with the Department of Environment and the Department for Planning and Infrastructure to ensure that proposed developments in the catchment of the reserve consider groundwater allocation limits that have been set for the relevant groundwater area. [HIGH]			

THOMSONS LAKE NATURE RESERVE: MANAGEMENT SUMMARY

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
PART C. MANAGING THE NATURAL ENVIRONMENT (CONTINUED)				
WETLAND AND CATCHMENT MANAGEMENT **Managing water quality** • Water quality and indicators of wetland health such as macroinvertebrates have been studied at Thomsons Lake since 1985. • A number of factors influence the water quality of Thomsons Lake, particularly surrounding land uses, and runoff from these into the groundwater. • The Water Corporation will monitor the water quality of Thomsons Lake, for the foreseeable future, as an environmental condition for the development of the Southern Lakes Drainage Scheme.	OBJECTIVE 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. THIS WILL BE ACHIEVED BY: 1. Liaising with the City of Cockburn and Department of Environment regarding the preparation and implementation of an Integrated Catchment Management Plan for Thomsons Lake. [HIGH] 2. Promoting the implementation of wetland and water sensitive design techniques for developments within the catchment of Thomsons Lake. [HIGH] 3. Protecting and re-establishing wetland fringing vegetation around Thomsons Lake. [HIGH] 4. Liaising with the Water Corporation and Department of Environment regarding the monitoring of water quality. [HIGH]	Changes in richness, relative abundance and community composition of naturally occurring aquatic macroinvertebrate populations.	Subject to natural variation[1], no decline in the richness of the aquatic macroinvertebrate community from the records described in the monitoring report provided by Wild and Davis (2004) to the Water and Rivers Commission (DoE).[2]	Every three years.

• Elevated nutrient levels have been recorded at the lake in the recent past and the potential for further nutrient enrichment remains high, particularly if the lake does not dry out annually. • Concentrations of total phosphorus above 150 µg/L are usually associated with poor water quality and nuisance midge swarms. • Due to nutrient assimilation, the current dry phase is assisting in reducing the nutrients levels in the surface water of the lake. • The appropriate management of adjoining land is of major importance for the protection of Thomsons Lake. As such, catchment management initiatives will need to be established. • Thomsons Lake is surrounded by a significant vegetation buffer that helps to reduce the level of nutrients in the lake through filtration and storage.		Concentrations of total P in the water column.	Maximum concentration of total P < 150 micrograms/L.	Every three years.

[1] The natural variations referred to will be as advised by CALM Science.

[2] This report documents richness recorded on an annual basis since 1996 (and at less frequent intervals from 1989).

THOMSONS LAKE NATURE RESERVE: MANAGEMENT SUMMARY

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
PART C. MANAGING THE NATURAL ENVIRONMENT (CONTINUED)				
NATIVE ANIMALS AND HABITATS • Thomsons Lake was designated to the List of Wetlands of International Importance under the Convention on Wetlands (Ramsar, Iran, 1971) in 1990. • It is an important breeding ground for local birds, and supports 21 species protected under the Japan–Australia Migratory Birds Agreement (JAMBA) and/or the China–Australia Migratory Birds Agreement (CAMBA) and is a summer refuge for 16 migratory bird species. • The reserve provides habitat for 66 species of bush birds and 69 species of native waterbirds. It supports one Priority fauna species and two specially protected bird species. • The main threats to the native fauna are inappropriate water levels and water quality, predation by foxes, environmental weeds and unplanned fire.	**OBJECTIVES** 1. To conserve indigenous fauna, with an emphasis on threatened and priority species and those protected by international agreements. 2. To conserve and enhance the reserve's habitat values for migratory waders as per the management requirements for Ramsar-listed wetlands. **THIS WILL BE ACHIEVED BY:** 1. Managing water levels of Thomsons Lake to provide appropriate waterbird habitat, through the implementation of the Water Supplementation Program. [HIGH] 2. Preparing and implementing the Pest Animal Control Plan for regional parks. Specifically, continuing to control foxes in the reserve. [HIGH] 3. Controlling *Typha orientalis* to prevent encroachment onto the mudflats of the lake. [HIGH]	Changes in species diversity of migratory wading birds. Changes in the abundance of selected naturally occurring fauna species.	Subject to natural variation, maintain or increase the species diversity of migratory wading birds from 2005 levels. Subject to natural variation, no decline in the abundance of selected naturally occurring fauna species from 2005 levels.	Every three years. Every three years.

	4. Encouraging and supporting groups (e.g. Birds Australia, tertiary institutions etc.) to undertake specific research and/or monitoring projects within the reserve. [MEDIUM] 5. Preparing and implementing recovery plans for threatened fauna species identified in the reserve. [MEDIUM]	Change in the total area of *Typha orientalis* within the reserve.	A decrease of at least 3% in the total area of *Typha orientalis* from 2005 levels each report period (three years) over the next ten years.	Every three years.
NATIVE PLANTS AND PLANT COMMUNITIES • The reserve supports 360 native plant species, comprising four regional floristic groups of the Swan Coastal Plain and one Priority species. • Vegetation communities in the reserve are representative of those once widespread on the Swan Coastal Plain that have now been significantly cleared. • The main threats to the vegetation include environmental weeds, unplanned fire, dieback, decreasing water levels and a kangaroo population in excess of the reserve's carrying capacity.	**Objective** To conserve indigenous plant species and communities, particularly threatened or priority species. **This will be achieved by:** 1. Preparing and implementing the Weed and Rehabilitation Plan for Beeliar Regional Park. [HIGH] 2. Controlling the size of the kangaroo population in the reserve. [HIGH] 3. Reducing the risk of introducing and spreading *Phytophthora cinnamomi*. [HIGH] 4. Managing the water levels of the lake to reflect historical regimes of inundation by implementing the Thomsons Lake Water Supplementation Program. [HIGH]	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.

THOMSONS LAKE NATURE RESERVE: MANAGEMENT SUMMARY

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
PART C. MANAGING THE NATURAL ENVIRONMENT (CONTINUED)				
NATIVE PLANTS AND PLANT COMMUNITIES		Change in the density and diversity of understorey vegetation. ·Changes in the health of terrestrial plant communities adjacent to the lake	An increase in the density and diversity of understorey vegetation from 2005 levels. No decline in the health of the terrestrial plant communities as recorded by the vegetation monitoring data collected on an annual basis for the DoE.	Every five years. Every three years.

ENVIRONMENTAL WEEDS • 131 weed species have been identified within the reserve. As rated in the Environmental Weed Strategy for Western Australia, according to their impacts on biodiversity, there are 15 High, 57 Moderate, 14 Mild, 35 Low, and 10 species that are either not listed or not rated. • *Typha orientalis* has the potential to further reduce the area of mudflats and invade the emergent native vegetation at Thomsons Lake and hence is a major management issue. • Other weed species threatening reserve values include arum lily, pampas grass and cape tulip. • Drains that flow into the reserve are a major source of weeds.	**Objective** To prevent species loss and community decline from weed invasion. **This will be achieved by:** 1. Preparing and implementing the Weed and Rehabilitation Plan for Beeliar Regional Park. [HIGH] 2. Controlling the spread of *T. orientalis*. [HIGH] 3. Encouraging and supporting the community in undertaking weed control works in the reserve. [HIGH] 4. Liaising with the Water Corporation and City of Cockburn regarding weed control in drains that flow into the reserve. [HIGH] 5. Monitoring for, and eradicating, new populations of weeds rated as High in the *Environmental Weed Strategy for Western Australia*. [HIGH]	Changes in abundance and distribution of priority environmental weeds (to be determined through a weed and rehabilitation plan). Change in the total area of *Typha orientalis* within the reserve.	No increase in the abundance and distribution of priority environment al weeds from 2005 levels. A decrease of at least 3% in the total area of *Typha orientalis* from 2005 levels each report period (three years) over the next ten years.	Every three years. Every three years.

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
PART C. MANAGING THE NATURAL ENVIRONMENT (CONTINUED)				
INTRODUCED AND OTHER PROBLEM ANIMALS • Introduced animals recorded within the reserve include feral cats and bees, foxes and rabbits. Foxes have all but been eradicated since the introduction of baiting and construction of the vermin-proof fence in 1993. • The reserve has a population of western grey kangaroos within the vermin-proof fence, numbers of which currently exceed a sustainable level. • The initial management intent is to reduce the kangaroo population to a sustainable level by culling using licensed shooters, with on-going control as necessary. • The method of kangaroo control will be subject to review over the life of this management plan.	**OBJECTIVE** To prevent, and where possible, negate the impacts of problem animals on the reserve's values. **THIS WILL BE ACHIEVED BY:** 1. Preparing and implementing the Regional Parks Pest Animal Control Plan. [HIGH] 2. Continuing to control foxes in the reserve. [HIGH] 3. Controlling problem species such as feral cats, bees and rabbits as necessary and in accordance with operational priorities. [MEDIUM] 4. Reducing and maintaining the kangaroo population at a sustainable level by culling using licensed shooters. [HIGH] 5. Developing and implementing a communication strategy in relation to the control of the kangaroo population. [HIGH]	Changes in the kangaroo population of the reserve. Changes in the abundance of selected naturally occurring native fauna species.	To maintain the kangaroo population at a sustainable level. Subject to natural variations, no decline in the abundance of selected naturally occurring fauna species (excluding kangaroos) from 2005 levels.	Every three years. Every three years.

DISEASE • Part of the southeastern section of Thomsons Lake is affected by *Phytophthora cinnamomi*. This is the most significant disease threat to native flora and fauna habitats within the reserve. • Management of *P. cinnamomi* within the nature reserve will focus on constraining the human-assisted establishment of new infestations.	**Objective** To prevent further human-assisted introduction and/or spread of *Phytophthora cinnamomi*. **This will be achieved by:** 1. Establishing the distribution of *P. cinnamomi* infection in the reserve. [HIGH] 2. 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 reserve. [HIGH] 3. Ensuring soils and other materials brought into the reserve are free of *P. cinnamomi*. [HIGH]	Changes in the occurrence of *Phytophthora cinnamomi* infections in the reserve.	No new human-assisted occurrences or spread of *Phytophthora cinnamomi* in the reserve over the next ten years.	Every five years.

THOMSONS LAKE NATURE RESERVE: MANAGEMENT SUMMARY

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
PART C. MANAGING THE NATURAL ENVIRONMENT (CONTINUED)				
FIRE • Unplanned fire is a significant threat to the natural and cultural values of the reserve. • Fire management at Thomsons Lake is guided by CALM's *Policy Statement 19 - Fire Management* (subject to final consultation). • CALM, FESA and the City of Cockburn have prepared a *Fire Working Arrangements and Suppression Response Plan* for Beeliar Regional Park. • Fire suppression in the reserve is the responsibility of FESA, whilst CALM is responsible for pre and post-suppression works. • Large infestations of introduced bulrush are fire hazards, as fires in such vegetation are difficult to control and can cause damage to fringing vegetation.	**OBJECTIVE** To protect the biodiversity of the reserve, as well as people and property, by minimising the impact of unplanned fire. **THIS WILL BE ACHIEVED BY:** 1. Implementing the *Beeliar Regional Park Fire Working Arrangements and Suppression Response Plan (2002)*, in conjunction with the City of Cockburn and FESA. [HIGH] 2. Initiating pre and post suppression works to minimise the spread of plant diseases and weeds in the reserve. [HIGH]			

PART D. MANAGING CULTURAL HERITAGE				
INDIGENOUS AND NON-INDIGENOUS HERITAGE • Thomsons Lake, and the protection of its Indigenous heritage, is important to local Aboriginal people. • The reserve contains three registered sites under the *Aboriginal Heritage Act 1972*. • One registered native title claim covers Thomsons Lake Nature Reserve.	**Objective** To protect the reserve's cultural heritage. **This will be achieved by:** 1. Ensuring management obligations are fulfilled according to the *Aboriginal Heritage Act 1972* and the *Native Title Act 1993* prior to any planning or public works being undertaken in the reserve. [HIGH] 2. Seeking involvement of local Aboriginal and historic groups in the management of the reserve. [HIGH]			

THOMSONS LAKE NATURE RESERVE: MANAGEMENT SUMMARY

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
PART E. MANAGING VISITORS				
VISITOR OPPORTUNITIES AND USE • Thomsons Lake is a valuable place for the local community to undertake passive recreation and nature appreciation. • The most popular visitor uses are bushwalking and bird watching. • Horse riding is an historical use and will be allowed to continue outside of the vermin-proof fence 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.	**OBJECTIVE** To provide for passive, low-impact visitor uses in a manner that is consistent with the reserve's purpose and values, and which minimises conflict between visitors. **THIS WILL BE ACHIEVED BY:** 1. Continuing to provide opportunities for bushwalking and bird watching. [HIGH] 2. Prohibiting domestic animals from the reserve. [HIGH] 3. Reviewing the appropriateness of horse riding at Thomsons Lake over the life of the plan. [MEDIUM]			

VISITOR ACCESS • Access within the reserve is provided for a limited number of recreational pursuits as well as for management and emergency vehicles. • Uncontrolled access is largely restricted due to the vermin-proof fence. • Pedestrian access will be formalised and sign posted using the existing firebreaks and management tracks, which will link to existing and proposed trails in other parts of Beeliar Regional Park. • The main access to Thomsons Lake is on Russell Road. This is proposed to be improved as part of the works program to upgrade Russell Road to dual carriageway. • Boat access on the lake is only permitted for management and scientific research purposes.	**Objective** To provide safe and convenient access within the reserve, for visitors and management, that is consistent with the protection of the reserve's values. **This will be achieved by:** 1. Upgrading degraded sections of the walk trails. [HIGH] 2. Installing directional signs on the trails, consistent with the Sign System for Regional Parks. [HIGH] 3. Upgrading vehicle access and parking at Russell Road and Branch Circus. [HIGH] 4. Prohibiting the use of recreational watercraft (including model boats) on the lake. [HIGH] 5. Allowing for emergency response within the reserve and ensuring all paths enable access by emergency vehicles. [MEDIUM] 6. Implementing the Regional Parks Visitor Risk Management Program. [MEDIUM]			

THOMSONS LAKE NATURE RESERVE: MANAGEMENT SUMMARY

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
PART F. MANAGING SUSTAINABLE RESOURCE USE				
SCIENTIFIC RESEARCH AND USE • Research is included in the purpose for Thomsons Lake Nature Reserve, and the reserve provides many opportunities for research. • Comprehensive studies of Thomsons Lake should assess water quality and water levels of the lake, ground water interaction, waterbirds, macroinvertebrates and terrestrial and wetland flora and fauna.	**OBJECTIVES** 1. 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. 2. To support and promote external research that will assist in the implementation of the management plan. **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. [MEDIUM] 3. Supporting, and where possible, seeking grant applications to encourage scientific research and monitoring within the reserve. [MEDIUM]			

REHABILITATION • Degradation and loss of natural vegetation has occurred at Thomsons Lake, mainly as a result of an over-population of kangaroos, frequent unplanned fire, decreasing water levels and invasion of weeds. • Only local native species should be used for rehabilitation purposes.	**Objective** To restore degraded areas of the reserve to a condition resembling the natural environment. **This will be achieved by:** 1. Preparing and implementing the Weed and Rehabilitation Plan for Beeliar Regional Park. [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] 3. Coordinating rehabilitation works with weed control and fire protection. [HIGH] 4. Encouraging members of the local community and schools to participate in rehabilitation works. [HIGH] 5. Ensuring mulch and soil used in rehabilitation works does not contain unwanted seeds or plant diseases. [HIGH] 6. Facilitating the occurrence of natural regeneration by controlling the size of the kangaroo population in the reserve. [HIGH]			

THOMSONS LAKE NATURE RESERVE: MANAGEMENT SUMMARY

KEY POINTS	OBJECTIVES AND STRATEGIES	KEY PERFORMANCE INDICATORS*		
		PERFORMANCE MEASURE	TARGET	REPORTING REQUIREMENTS
PART G. INVOLVING THE COMMUNITY				
INFORMATION, EDUCATION AND INTERPRETATION • Thomsons Lake provides a valuable opportunity to improve community awareness about wetland ecosystems and Ramsar-listed wetlands. • It is important for the effective implementation of this management plan that community understanding and support is fostered for the reserve. • A communication strategy has been prepared for Beeliar Regional Park, aspects of which are relevant to Thomsons Lake. • There is very little information available about Thomsons Lake's Ramsar listing, and the significance of Ramsar listed wetlands. This will be addressed in the development of an Interpretation Plan for Beeliar Regional Park.	**OBJECTIVES** 1. To increase community awareness, appreciation and understanding of the reserve's values, and to gain support for management practices. 2. To increase community awareness, appreciation and understanding of Thomsons Lake's listing as a Ramsar site, and the significance of Ramsar listed wetlands. **THIS WILL BE ACHIEVED BY:** 1. Implementing the Regional Parks Communication Strategy. [HIGH] 2. Preparing and implementing an Interpretation Plan for Beeliar Regional Park. [HIGH] 3. Providing information to visitors on reserve values and issues such as Ramsar listing, visitor safety, permitted activities and regulations. [MEDIUM]			

WORKING WITH THE COMMUNITY • Community involvement is an integral component of CALM's operations, and community groups and individuals are encouraged to be involved in the management of Thomsons Lake. • Community support is essential for the successful implementation of this management plan. • CALM will seek to establish a "Friends of" group for Thomsons Lake.	**Objective** To facilitate community involvement in the management of the reserve. **This will be achieved by:** 1. Involving the community in the implementation of this management plan. [HIGH] 2. Establishing a "Friends of" group for Thomsons Lake. [HIGH] 3. Continuing to encourage, promote and support volunteers with essential resources to help them undertake volunteer activities. [HIGH]	Change in volunteer hours contributed to the management of the reserve.	No decrease in volunteer hours contributed to the management of the reserve from 2005 levels.	Every three years.

**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.*

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