LAKE MACQUARIE STATE CONSERVATION AREA, PULBAH ISLAND NATURE RESERVE AND MOON ISLAND NATURE RESERVE

PLAN OF MANAGEMENT

NSW National Parks and Wildlife Service

Part of the Department of Environment and Conservation (NSW)

January 2005

This plan of management was adopted by the Minister for the Environment on 21 January 2005.

Acknowledgments: This plan of management is based on a draft plan prepared by Central Coast Hunter Range Region officers Peta Norris, Jeff Johnston and Bronwyn Conyers.

The contribution of the members of the Lake Macquarie State Conservation Area Advisory Committee to the preparation of this plan is gratefully acknowledged.

Cover photograph of a pelican on Pourmalong Creek, Morisset, Lake Macquarie State Conservation Area by Peta Norris, NPWS.

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FOREWORD

Lake Macquarie State Conservation Area (SCA) consists of six separate areas on the shores of Lake Macquarie. Pulbah Island Nature Reserve is located in the middle of Lake Macquarie, while Moon Island Nature Reserve is situated off the coast at the entrance to Lake Macquarie. All three reserves lie between Newcastle and Lake Munmorah on the Central Coast of New South Wales.

The special values of Lake Macquarie State Conservation Area, Pulbah Island Nature Reserve and Moon Island Nature Reserve include their significant native vegetation communities and threatened species, their scenic value, and their importance in providing passive recreational opportunities for the region. Pulbah Island is of importance for Aboriginal heritage and Moon Island provides important sea bird habitat.

The New South Wales *National Parks and Wildlife Act 1974* requires that a plan of management be prepared for each state conservation area and nature reserve. A plan of management is a legal document that outlines how a reserve will be managed in the years ahead.

A draft plan of management for Lake Macquarie State Conservation Area, Pulbah Island Nature Reserve and Moon Island Nature Reserve was placed on public exhibition for three months from 7 March 2003 until 2 June 2003. The exhibition of the plan of management attracted 14 submissions which raised 12 issues. All submissions received were carefully considered before adopting this plan of management.

This plan of management provides for the protection of visual and aesthetic values and for the conservation of significant vegetation communities and rare and threatened plant and animal species of all three reserves. It also provides for sustainable recreational use of the state conservation area, protection of the Aboriginal cultural values of Pulbah Island, and protection of Moon Island's seabird nesting and roosting habitat.

This plan of management establishes the scheme of operations for Lake Macquarie State Conservation Area, Pulbah Island Nature Reserve and Moon Island Nature Reserve. In accordance with section 73B of the *National Parks and Wildlife Act 1974*, this plan of management is hereby adopted.

Bob Debus
Minister for the Environment

CONTENTS

1. THE MANAGEMENT CONTEXT

1.1 THE LEGISLATIVE AND POLICY FRAMEWORK

The management of state conservation areas and nature reserves in NSW is in the context of a legislative and policy framework, primarily the *National Parks and Wildlife Act 1974*, the National Parks and Wildlife Regulation, the *Threatened Species Conservation Act 1995* and the policies of the National Parks and Wildlife Service (NPWS). The policies arise from the legislative background and internationally accepted principles of park management. They relate to nature conservation, Aboriginal and historic heritage conservation, recreation, commercial use, research and communication.

Other legislation, international agreements and charters may also apply to management of the area. In particular, the *Environmental Planning and Assessment Act 1979* requires the assessment and mitigation of the environmental impacts of any works proposed in this plan.

A plan of management is a statutory document under the National Parks and Wildlife Act. Once the Minister has adopted a plan, no operations may be undertaken within Lake Macquarie State Conservation Area (SCA), Pulbah Island Nature Reserve (NR) or Moon Island Nature Reserve except in accordance with the plan. The plan will also apply to any future additions to the SCA. Where management strategies or works are proposed for Lake Macquarie SCA or Pulbah Island NR or Moon Island NR or any additions that are not consistent with the plan, an amendment to the plan will be required.

1.2 STATE CONSERVATION AREAS

State conservation areas are reserved under the *National Parks and Wildlife Act 1974* to protect and conserve areas that contain significant or representative ecosystems, landforms or natural phenomena or places of cultural significance; that are capable of providing opportunities for sustainable visitor use and enjoyment, the sustainable use of buildings and structures or research; and that are capable of providing opportunities for uses permitted under other provisions of the Act.

Under the Act, state conservation areas are managed to:

- conserve biodiversity, maintain ecosystem functions, protect natural phenomena and maintain natural landscapes;
- conserve places, objects and features of cultural value;
- provide for the undertaking of uses permitted under other provisions of the NPW Act (including uses permitted under section 47J, such as mineral exploration and mining), having regard to the conservation of the natural and cultural values of the state conservation area;
- provide for sustainable visitor use and enjoyment that is compatible with conservation of the area's natural and cultural values and with uses permitted in the area;
- provide for sustainable use (including adaptive reuse) of any buildings or structures or modified natural areas having regard to conservation of the area's natural and cultural values and with other uses permitted in the area; and
- provide for appropriate research and monitoring.

The Act also requires review of the classification of state conservation areas every 5 years to determine whether they should receive either a national park or nature reserve classification. The classification review for state conservation areas is described in section 47M of the Act and is undertaken in consultation with the Minister administering the *Mining Act 1992*.

1.3 NATURE RESERVES

Nature reserves are reserved under the National Parks and Wildlife Act to protect and conserve areas containing outstanding, unique or representative ecosystems, species, communities or natural phenomena.

Under the Act, nature reserves are managed to:

- conserve biodiversity, maintain ecosystem functions, and protect geological and geomorphological features and natural phenomena;
- conserve places, objects, features and landscapes of cultural value;
- promote public appreciation, enjoyment and understanding of the reserve's natural and cultural values; and
- provide for appropriate research and monitoring.

Nature reserves differ from national parks in that they do not have as a management principle to provide for visitor use.

1.4 ABORIGINAL PLACES

Pulbah Island Nature Reserve is declared an Aboriginal Place under the National Parks and Wildlife Act.

An Aboriginal Place is an area of special significance to Aboriginal culture and declaration provides recognition of the significance of the area and its heritage values which relate to traditions, observances, customs, beliefs or history of Aboriginal people.

This declaration does not change the status of the land but may limit use as far as preventing activities that may destroy, damage or deface the Aboriginal Place.

2. LAKE MACQUARIE STATE CONSERVATION AREA, PULBAH ISLAND NATURE RESERVE AND MOON ISLAND NATURE RESERVE

2.1 LOCATION AND REGIONAL CONTEXT

Lake Macquarie is the largest coastal lake in New South Wales, with an area of approximately 120 square kilometres and around 170 kilometres of foreshore. The lake is located 15 kilometres south of Newcastle and 150 kilometres north of Sydney.

Lake Macquarie SCA comprises approximately 650 hectares of bushland in six separate areas on the western and south-eastern foreshores of the lake (centre pages). The Awaba Bay, Wangi Point, Myuna Bay, Chain Valley Bay and Point Wolstoncroft sections of the reserve were gazetted in November 1996. The Morisset portion was added in January 1999. Awaba Bay, Wangi Point, Morisset Hospital and Myuna Bay are in the Lake Macquarie Local Government Area (LGA) and Chain Valley Bay and Point Wolstoncroft are in the Wyong LGA. The SCA conserves important remnant bushland around Lake Macquarie, however a number of significant areas remain outside the NPWS reserve system. The contribution of all these bushland areas to conservation in the region is significant. Investigation of the viability of including these areas in the NPWS reserve system would be worthwhile.

The Awaba Bay portion of the SCA consists of 43.2 hectares with 1.6 kilometres of foreshore on the western side of the lake, between Bolton and Marmong Points. Prior to reservation, the bushland was managed by the NSW Department of Housing and a 30 metre strip along the foreshore by the Department of Land and Water Conservation (DLWC). It is an important recreational area for the local community.

The SCA conserves another 42.3 hectares of bushland at Wangi Point, with approximately 2.9 kilometres of foreshore. This section includes the Wangi Point Tourist Park, which is managed by Lake Macquarie City Council (LMCC) under a lease from the NPWS. The reserve was previously Crown Land managed by LMCC. Wangi Point is also surrounded by residential development and provides recreation for locals, and cabin, van and tent accommodation for visitors in the Tourist Park. The Wangi Point portion of the SCA abuts a section of council reserve to the west on the Wangi Ridge.

At Myuna Bay, 11 hectares and 1.1 kilometres of foreshore are conserved within the SCA. The south eastern section was previously owned and managed by Pacific Power as part of the Wangi Power Station. DLWC was responsible for the north western portion of the reserve and a thirty metre strip along the foreshore. The reserve abuts residential development to the north-west and south-east and seems to be used primarily for fishing.

The Morisset portion of the SCA was previously Crown Land managed by the NSW Department of Health. It conserves 174 hectares and 4 kilometres of foreshore around the Morisset Hospital complex. Until recently the Department of Health provided low key camping at Woods Point, mainly for Department staff and some external groups such as scouts and a variety of clubs. The main users of the foreshore areas are visitors to the hospital, patients and locals.

The Chain Valley Bay portion of the SCA conserves 272 hectares of bushland behind 600 metres of foreshore on the south eastern side of the lake. The majority of this land was previously owned by Pacific Power, with the DLWC responsible for a thirty metre strip along the foreshore. Locals and anglers are the main users of this section of the park.

At Point Wolstoncroft, the SCA conserves a narrow peninsula of 107.8 hectares with 6 kilometres of foreshore on the south eastern shore of the lake. The NSW Department of Sport and Recreation (DSR) previously managed the area. The DSR continues to manage part of the area under arrangements that are to be formalised in a lease with the NPWS. A popular sport and recreation centre is located in this section of the SCA, providing accommodation, conference facilities, a recreation hall and sporting facilities including tennis courts and swimming pool.

Pulbah Island is a 70 hectare nature reserve situated in the south of Lake Macquarie. Prior to 1917, the island was Crown Land under the control of LMCC and leased for grazing. A trust similar to the Taronga Zoo Trust was formed in 1920 to manage the island as a sanctuary and a variety of native animals were introduced. This use ceased around 1942. The island was dedicated as a nature reserve in 1970. Pulbah Island is a significant place in Aboriginal culture and was declared an Aboriginal place in 1982. The island is used for bushwalking and picnicking.

Moon Island Nature Reserve is a small flat plateau lying at the entrance to Lake Macquarie, 600 metres east of Swansea Heads. The island is 250 metres long and 90 metres wide covering an area of 2.25 hectares. Moon Island was formerly Crown land and was declared Moon Island Faunal Reserve No 13 on 1 April 1960 under the Fauna Protection Act 1948. There is a navigational beacon on the northern side of the island. Rock fishing and bird watching are the main recreational activities.

2.2 IMPORTANCE OF LAKE MACQUARIE STATE CONSERVATION AREA, PULBAH ISLAND NATURE RESERVE AND MOON ISLAND NATURE RESERVE

Lake Macquarie SCA and Pulbah Island NR protect some of the few remaining parcels of natural bushland on Lake Macquarie. A number of significant areas remain outside the NPWS reserve system. The contribution of all these bushland areas to conservation in the region is significant. Investigation of the viability of including these areas in the NPWS reserve system would be worthwhile. Moon Island NR (also known as Green Island or Nirritiba) protects a small rocky offshore island at the entrance to Lake Macquarie. Together with nearby offshore island nature reserves (such as Bird Island NR to the south), Moon Island provides important roosting and nesting areas for seabirds in the region.

The reserves are aesthetically significant: the green headlands and foreshores, cliffs and coves all contribute to the beauty and spectacular scenery of Lake Macquarie and are a pleasing contrast to the urban and industrial landscapes of the region.

Local communities value the bushland of Lake Macquarie SCA and Pulbah Island NR highly because it provides an opportunity to escape from the surrounding urban environment and to enjoy the landscape of the lake in a peaceful, natural setting. The reserves are popular for walking, fishing, swimming, boating, bird watching and nature appreciation. Moon Island NR is a popular rock fishing and bird watching site.

As part of the system of protected coastal lands, the reserves contribute to the conservation of the region's biodiversity and provide important habitat for native animals including bats, wallabies, kangaroos, brush and ring-tailed possums, native rats and mice, approximately one hundred and ten species of birds, and a number of amphibians and reptiles.

2.2.1 Lake Macquarie State Conservation Area

Lake Macquarie SCA supports a diversity of inadequately conserved vegetation types. Six vegetation communities in the SCA are not conserved elsewhere in the NPWS reserve system and an additional seven communities are poorly conserved

(Bell, 1998). One endangered plant (*Acacia bynoeana*), three vulnerable plants (*Angophora inopina, Syzygium paniculatum* and *Tetratheca juncea*), and one Rare or Threatened Australian Plant (ROTAP) *Macrozamia flexuosa,* have been recorded (Bell, 1998; Awaba Bay Landcare Group, 2000). The endangered terrestrial orchid, *Microtis angusii* is thought to occur in the southern part of the SCA and an extremely rare recently-named orchid (*Genoplesium insignis*) is also found in the south of the reserve (Jones, 2001).

More than 400 native plants have been recorded in Lake Macquarie SCA (Awaba Bay Landcare Group, 2000; Bell, 1998; Bell, 2000). This high species diversity is a reflection of the complex geology of the region (Bell, 1998).

Five vulnerable fauna species occur in the SCA - the Pied Oystercatcher (*Haematopus longirostris*), Wallum Froglet (*Crinia tinnula*), Common Bentwing Bat (*Miniopterus schreibersii*) Little Bentwing Bat (*Miniopterus australis*) and the Squirrel Glider (*Petaurus norfolcensis*). An additional ten or so vulnerable or endangered species have been recorded in close proximity to the reserve and are likely to occur in the SCA.

2.2.2 Pulbah Island Nature Reserve

Three of the five native vegetation communities on Pulbah Island NR are considered poorly or very poorly conserved on a local, regional and national scale (Bell, 1998). It is likely that the vulnerable *Tetratheca juncea* and the ROTAP *Macrozamia flexuosa* occur on the island (Bell, 1998).

Koalas are known to occur on Pulbah Island, which is also home to sugar gliders, possums and a wide range of birds, including a breeding pair of white breasted sea eagles (*Haliaeetus leucogaster*).

The Awabakal people consider the island sacred and called it Boroyirong. They believed that the monster Rogoyarran protected the island. It was Rogoyarran's emergence from under ground which formed both the island and lake. It was believed that the monster would overturn the canoes of anyone attempting to land on Pulbah Island. Shell middens have been recorded at several locations on the island.

2.2.3 Moon Island Nature Reserve

Moon Island is significant as a roosting and breeding site for seabirds. One breeding pair of the vulnerable Sooty Oystercatcher (*Haematopus fuliginosus*) has been recorded on the island along with up to 15 breeding pairs of the Little Penguin (*Eudyptula minor*). The Wedge-tailed Shearwater (*Puffinus pacificus*), Silver Gull (*Larus novaehollandiae*) and Dominican Gull (*Larus dominicanus*) are also known to breed there (Gray and Gwynne, 1974; Lane, 1979).

Moon Island is sparsely vegetated. Coarse grasses, Pig Face (*Carpobrotus glaucescens*) and some clumps of the introduced Prickly Pear (*Opuntia stricta*) comprise the only vegetation on the island which occurs on a small plateau approximately 90 metres long and 40 metres wide (Gray and Gwynne, 1974).

The Aboriginal name for Moon Island is Nirritiba meaning the place of mutton-birds. There are 19th century missionary reports of Awabakal people visiting Moon Island, at the entrance to Lake Macquarie, to collect mutton-bird chicks and eggs (Gunson, 1974).

Moon Island is thought to have played a part in Captain William Reid's mistake, which lead to the discovery of Lake Macquarie. Reid mistook Moon Island for Nobbys (at the entrance to Newcastle harbour) in July 1800 (Coulten, 1967).

3. OBJECTIVES OF MANAGEMENT

3.1 SPECIFIC OBJECTIVES FOR LAKE MACQUARIE STATE CONSERVATION AREA

In addition to the general purposes and principles for management of state conservation areas, specific objectives for the management of Lake Macquarie State Conservation Area include:

- protection of visual and aesthetic values;
- conservation of biodiversity, with emphasis on protection of significant vegetation communities and rare and threatened species;
- promotion of community involvement in the management of the SCA; and
- provision of sustainable recreational opportunities.

3.2 SPECIFIC OBJECTIVES FOR PULBAH ISLAND NATURE RESERVE

In addition to the general purposes and principles for management of nature reserves, specific objectives for Pulbah Island Nature Reserve include:

- protection of visual and aesthetic values;
- conservation of biodiversity, with emphasis on protection of significant vegetation communities;
- protection of the Aboriginal cultural values of the island; and
- promotion of community involvement in the management of the NR.

3.3 SPECIFIC OBJECTIVES FOR MOON ISLAND NATURE RESERVE

In addition to the general purposes and principles for management of nature reserves, specific objectives for Moon Island Nature Reserve include:

- protection of visual and aesthetic values; and
- conservation of biodiversity, with emphasis on protection of seabird nesting and roosting habitat.

4. MANAGEMENT POLICIES AND ACTIONS

4.1 NATURAL HERITAGE

4.1.1 Geology, Geomorphology, Soils and Catchments

Lake Macquarie is at the north-eastern edge of the Sydney Basin, a major geological structural unit of eastern Australia which extends over central-eastern NSW. The geology of Lake Macquarie consists mainly of Triassic age Munmorah Conglomerates in the south and west and Permian Newcastle Coal Measures in the north (Department of Mines 1966. Rose, Jones and Kennedy 1966. Brunker and Rose 1967). This is the only region where the Permian Newcastle Coal Measures and Triassic Narrabeen Sandstones (Munmorah Conglomerates) interface, resulting in an unusual and complex mix of soil types. Along major water courses draining into Lake Macquarie, alluvium, gravels, sands, silts, and clays from the Quaternary period occur, often forming deep alluvial flats (Bell, 1998). Moon Island is a mix of sandstone and conglomerate geology. The Point Wolstoncroft, Wangi Point and Myuna Bay sections of Lake Macquarie SCA and Pulbah Island are predominantly sandstone and shale. Sandstone, shale and unconsolidated quaternary sediments occur at Chain Valley Bay and Morisset in Lake Macquarie SCA. At Awaba Bay in the SCA, the geology is primarily conglomerate and sandstone.

When sea levels rose between 10,000 and 6,000 ago, a barrier was formed at the entrance to Lake Macquarie by the deposition of marine sands, creating a shallow tidal lake with a comparatively narrow inlet. As its catchment is fairly small there has been relatively little sedimentation and little infilling. The average depth of the lake is around 8 metres, with a maximum depth near Pulbah Island of about 11 metres (Lake Macquarie City Council State of the Environment Report 1998).

Murphy and Tille (1993) have described and mapped the soil landscapes (unique landforms with their characteristic set of soils) of the Lake Macquarie region. Two landscapes predominate in the SCA: the Awaba erosional soil landscape at Wangi Point and Awaba Bay and the Doyalson erosional soil landscape elsewhere. A small area of the Warners Bay residual soil landscape is found in the more elevated sections of Awaba Bay. Because of the complex geology and local topographic variations there are numerous sites with different soils to those described below, but at too small a scale to have been mapped.

The soils of the Awaba Bay landscape are medium to coarse-grained, on transportation sites, with shallow uniform soils (lithosols) on steeper slopes. On more gentle slopes shallow to moderately deep texture contrast soils (soloths and yellow podzolics) occur. In undisturbed drainage lines texture contrast soils (soloths) have formed. The soils of the Warners Bay landscape are moderately deep texture contrast soils (gleyed podzolics and/or yellow podzolics).

The Doyalson erosional landscape soils include moderately deep yellow earths and texture contrast soils (yellow podzolics and soloths) on Munmorah Conglomerates. In drainage lines deep yellow earths, grey earths and texture contrast soils (soloths and gleyed podzolics) are found. These soils are all moderately to highly erodable, acid and with low nutrient levels.

Along the foreshore, on naturally flat areas and lower drainage lines alluvium, comprised of heavy dark sands, sandy loams and sandy clays, have been deposited. They are generally richer in nutrients, especially in disturbed drainage lines downstream of urban runoff. Sea grasses are present in the lake in ares adjoining the reserves.

The catchment of Lake Macquarie is comparatively small. The largest water courses that flow into the lake are Dora Creek, on the western side, and Cockle Creek in the north west. In the SCA the only permanent streams are Tiembula Creek, at Chain Valley Bay, and Duckhole Creek at Morisset.

The *Catchment Management Act 1989* aims to achieve cleaner water, reduced soil erosion, increased vegetation cover, the maintenance of ecological processes and a balanced and healthier environment. The Hunter / Central Rivers Catchment Management Authority has prepared a draft Blueprint for the Central Coast which includes coverage of these reserves. Certain draft actions are proposed for the Service in that plan.

Policies

* No development with potential to detract from the scenic/landscape values of either reserve will be undertaken by the Service.

* All works planned in the reserves will be consistent with the policies and guidelines of other departments with catchment responsibilities including Lake Macquarie City Council, NSW Fisheries, NSW Waterways Authority and the Department of Infrastructure, Planning and Natural Resources.

* The Service will seek to mitigate any adverse impacts arising from developments of surrounding lands on the reserves.

* The Service will liaise with other authorities to protect sea grass areas fringing the reserves.

* Existing visitor facilities in the state conservation area will be landscaped, maintained and/or modified to minimise their visual impact, and to improve the aesthetic and natural appearance of the surrounding areas.

* Development activities will be assessed to determine their impact on geological, geomorphic, pedological, catchment and landscape/aesthetic values.

* Development activities will incorporate best practise soil erosion and sedimentation control measures to prevent impacts on the landscape and physical values of the reserves.

* The landscape and physical values of the reserves will be protected by minimising erosion and undertaking, where necessary, rehabilitation works to re-establish natural processes.

* Areas disturbed by previous land uses will be rehabilitated using local soils and material free of contaminants.

* Fire trails and radiation zones will be developed to minimise threats from erosion by providing adequate drainage and erosion control measures.

* The NPWS will continue to review vehicle access requirements in the SCA with a view to minimise the number of roads and trails in the reserve.

* The Service will cooperate with the Hunter / Central Rivers Catchment Management Authority in undertaking actions identified in the approved Catchment Blueprint for the Central Coast.

* Fossicking will not be permitted within the reserves.

* The Service will continue to encourage scientific inquiry into the geomorphology and soils of the reserves.

Actions

* Grading of unsealed roads and fire trails will be preceded by the installation of siltation controls.

* Sediment traps installed on unsealed roads and/or walking tracks in the reserves will be properly maintained.

* As resources permit, the unsealed roads in the SCA will be sealed, with priority given to Wangi Point.

* An assessment will be made of the network of tracks and trails in the Chain Valley Bay and Morisset sections of the SCA: those not required for visitor access or fire management will be closed and rehabilitated.

* The Service will continue to actively participate on the Estuary and Coastal Management Committee and will contribute to the development of the Central Coast Catchment Management Blueprint.

* The NPWS will seek support and grant funding from the Waterways Authority for the sealing and landscaping of the boat ramp at Wangi Point, including definition of a parking area to prevent erosion and encroachment into bushland.

* Environmental assessments and plans for major works in the reserves will be provided to relevant authorities for comment.

4.1.2 Native and Introduced Plants

Native Plants - Lake Macquarie SCA

More than 400 native plants have been recorded in Lake Macquarie SCA making the area particularly diverse compared to other reserves in the region (Bell, 1998).

The endangered *Acacia bynoeana* and vulnerable *Angophora inopina, Syzygium paniculatum* and *Tetratheca juncea* are found in the reserve, as is the ROTAP *Macrozamia flexuosa* (Bell, 1998. Awaba Bay Landcare Group, 2000). The endangered terrestrial orchid, *Microtis angusii* is thought to occur in the southern parts of Lake Macquarie SCA, although its presence has not been confirmed. An extremely rare orchid *Genoplesium insignis* is known to occur within the reserve. Twenty three species of orchids have been recorded in the SCA are listed in appendix 2. Another five rare plants are likely to occur, but their presence has not been confirmed (Bell, 1998).

Lake Macquarie SCA marks the northern extent of *Acacia bynoeana* and the only known occurrence of *Angophora inopina* within a protected area. The record of *Macrozamia flexuosa* in the SCA currently represents the only known occurrence of this species in a protected area. Bell (1998) found *Eucalyptus oblonga* and *Xanthorrhoea minor ssp. minor* in Lake Macquarie SCA, representing a northerly extension of the known ranges of these species. Lake Macquarie SCA is also the only conservation reserve known to support all three species of Scribbly Gum *Eucalyptus haemastoma, Eucalyptus racemosa* and *Eucalyptus signata* (Bell, 1998).

Lake Macquarie SCA contains a range of inadequately conserved vegetation communities. Six vegetation communities in the SCA are not represented elsewhere in the conservation reserve system. These are the Permian Macquarie Paperbark Gully Forest, Coastal Sandplain Scribbly Gum Forest, Coastal Alluvial Depression Swamp Forest, Narrabeen Macquarie Headland Thicket, Macquarie Melaleuca Scrub-Forest and Alluvial Coastal Intermediate Heath. An additional seven communities have similar counterparts in other reserves, but are still considered poorly conserved. They are the Macquarie Relic Dry Rainforest, Narrabeen Macquarie Ironbark Forest, Narrabeen Crangan Bay Coastal Forest, Permian Macquarie Grassy Forest, Coastal Alluvial Flat Swamp Forest Complex, Narrabeen Coastal Impeded Sedgeland, and Freshwater Melaleuca Swamp Forest (Bell, 1998).

The eight communities considered to be adequately to moderately represented in conservation reserves are the Estuarine Saltmarsh, Estuarine Rushland, Estuarine Mangrove Open Scrub, Sydney Sandstone Sheltered Dry Forest, Narrabeen Doyalson Coastal Woodland, Narrabeen Coastal Clay Heath, Coastal Alluvial Mahogany Swamp Forest and Estuarine Swamp Oak Forest.

A summary description of the vegetation communities is contained in appendix 1.

Native plants - Pulbah Island Nature Reserve and Moon Island Nature Reserve

More than ninety native plants species have been recorded on Pulbah Island and five different vegetation communities have been identified by Bell (1998). Of these communities, three are considered poorly or very poorly conserved on a local, regional and national scale (Permian Macquarie Grassy Forest, Macquarie Relic Dry Rainforest and Macquarie Melaleuca Scrub Forest) (Bell, 1998). The Sydney Sandstone Sheltered Dry Forest and Estuarine Swamp Oak forest are present on Pulbah Island and both are considered adequately conserved. All of these communities also occur in Lake Macquarie SCA and are briefly described in appendix 1.

No threatened plant species have been recorded on Pulbah Island, however it is likely that the vulnerable *Tetratheca juncea* is present (Bell, 1998). The ROTAP *Macrozamia flexuosa* may occur on the island as Messmer, Bryce and Rupp (1941) recorded "*Macrozamia flexuosa* or *spiralis var. flexuosa*" which may have referred to this species, however its presence has not been recently confirmed (Bell, 1998).

Moon Island NR has not been comprehensively surveyed for vegetation. A small plateau approximately 90 metres long and 40 metres wide is the only vegetated area on the island. There are no trees or shrubs on the island and the native vegetation comprised mainly of grasses and Pig face (*Carpobrotus glaucescens*).

Introduced plants - Lake Macquarie State Conservation Area, Pulbah Island Nature Reserve and Moon Island Nature Reserve

Wangi Point, Point Wolstoncroft and Awaba Bay have been surveyed for weeds. The remainder of the SCA and nature reserves have not been systematically surveyed and the following is a general indication only of those present.

Bitou Bush (*Chrysanthemoides monilifera* ssp *rotundata*) is a declared noxious (W3) weed in Lake Macquarie and Wyong local government areas. This means that it must be prevented from spreading and its numbers and distribution reduced. It is also a weed of national significance. Invasion of native vegetation communities by Bitou Bush is a key threatening process under the NSW Threatened Species Conservation Act 1995 (TSC Act). Under the TSC Act a threat abatement plan

must be prepared to abate, ameliorate or eliminate the threat posed by Bitou Bush. Such a plan is in preparation. Bitou Bush is widespread throughout the SCA and Pulbah Island NR on foreshores and in forest communities. It is a major threat to vegetation at Point Wolstoncroft and on Pulbah Island.

Lantana (*Lantana camara*) is also widespread, especially in nutrient enriched gullies. It is found at Awaba Bay, Wangi Point, Myuna Bay, Morisset, Point Wolstoncroft and around the foreshore and in gullies on Pulbah Island.

Weeds declared noxious in Lake Macquarie and Wyong, which are known to occur in the SCA and nature reserves include Blackberry (*Rubus fruticosus*), Crofton Weed (*Ageratina adenophora)*, Pampas Grass (*Cortaderia selloana*), Salvinia (*Salvinia molesta*), Giant Parramatta Grass (*Sporobolus indicus var capensis*), Prickly Pear (*Opuntia stricta*), St Johns Wort (*Hypericum perforatum*) and African Boxthorn (*Lycium ferocissimum*). The latter two have been recorded so far only in the Point Wolstoncroft section of Lake Macquarie SCA. Point Wolstoncroft is known to have infestations of Salvinia and Prickly Pear. Salvinia has also been recorded at Wangi Point and Prickly Pear occurs on Moon Island. Salvinia, Pampas Grass, St Johns Wort, African Boxthorn, Parramatta Grass and Crofton Weed are W2 weeds in Lake Macquarie and Wyong which must be continuously suppressed and destroyed. Blackberry is a W3 weed in both LGAs which must be prevented from spreading and its distribution decreased, and prickly pear is a W4f weed (also in both LGAs) which must not be sold, propagated or distributed.

Some of the other environmental weeds occurring in the SCA and on Pulbah Island NR include Coral Trees (*Erythrina x sykesii*), Formosan Lily (*Lilium formosanum*), Madeira Vine (*Anredera cordifolia*), Cotton Bush (*Gomphocarpus fruticosus*), Blackberry nightshade *(Solanum nigrum*), Moth Vine (*Araujia horturum*), Mother Of Millions (*Bryphyllum delagoense*), Queensland Silver Wattle (*Acacia podalyriifolia*), Pennywort (*Hydrocotlye bonariensis*), Castor Oil Plant (*Ricinus communis*), Coastal Morning Glory (*Ipomoea cairica*), Morning Glory (*Ipomoea sp.*), Wild Tobacco Bush (*Solanum mauritianum*), Mickey Mouse Plant (*Ochna serrulata*), Small Leaf Privet (*Ligustrum lucidum*), Cassia (*Senna pendula*), Camphor Laurel (*Cinnamomum camphora*), Honeysuckle (*Lonicera japonica*), Inkweed (*Phytolacca octandra*), Turkey Rhubarb (*Rumex* [*Acetosa*] *sagittata*), Agave (*Agave americanum*), Trad (*Tradescantia albiflora*), Asparagus Fern (both *Protasparagus aethiopicus* and *Asparagus officinalis*) and Fat Hen (*Chenopodium album)*.

Herbaceous and annual weeds are widespread, especially in areas disturbed by previous land uses at Awaba Bay and Morisset and those areas adjoining urban development. Numerous grasses such as African Love Grass (*Eragrostis curvula*), Whisky Grass (*Andropogon virginicus*), Paspalum (*Paspalum dilatum*), Couch (*Cynodon dactylon*) and Kikuyu (*Pennisetum clandestinum*) occur in the SCA. Members of the daisy family (Asteraceae), such as Cobblers Peg (*Bidens pilosa*), Fireweed (*Senecio madagascariensis*), Scotch Thistle (*Cirsium vulgare*), Dandelion (*Taraxacum officinale*) and Fleabane (*Conyza bonariensis*) are also widespread in the SCA.

The Morisset section of the SCA in particular has an extensive degraded landscape formerly used for farming and grazing. Removal of livestock from this area is resulting in a proliferation of agricultural and environmental weeds.

No biological controls for Bitou Bush have been released in either reserve and it is unknown whether those released nearby in Munmorah SCA, the bitou seed fly and tip moth, have spread to Pulbah Island or the south eastern sections of Lake Macquarie. At Awaba Bay and Wangi Point Bitou Bush has been a target of local Landcare volunteers, with control undertaken mainly by handpulling seedlings and cutting and painting mature plants. The groups have worked on these programs for

a number of years and have substantially reduced the extent of Bitou Bush in both these sections of the reserve.

Control of Bitou Bush on Pulbah Island has mainly relied on occasional volunteer working bees, hand pulling the weed. Herbicide spraying near the foreshore has also been undertaken with good results. Aerial spraying which has been undertaken successfully in other reserves, is problematic in the SCA and NR because of the SCA's comparatively small and discontinuous areas, the proximity of the lake and urban areas, and in the case of Pulbah Island, the steep topography and canopy cover.

Other weeds that have been the target of control efforts include Lantana and Crofton Weed at Wangi Point and Awaba Bay by the Service and Landcare volunteers, and Prickly Pear and Salvinia at Point Wolstoncroft by contractors and NPWS staff.

Given the extent of weed invasion and infestation in both reserves, additional resources to those of the Service are required if any control programs are to be successful. Work undertaken at Wangi Point and Awaba Bay are good examples of control programs undertaken at the initiative of local members of the community, where primary and follow up work has been successful in curbing the spread of Bitou Bush and Lantana in native bushland areas.

Control of agricultural and environmental weeds in the degraded section of the SCA at Morisset presents significant challenges. The area is large, there are few native species other than mature trees, and the potential for any natural regeneration is considered low. Rehabilitation of the landscape to something resembling a self-sustaining natural system will require many years of intense management. Tree planting, direct native seeding and herbicide spraying of exotic plants will require significant long term planning and commitment.

Weed programs will focus on those weeds listed as key threatening processes and those weeds declared noxious which require control under legislation. Other environmental weeds will be controlled as part of these programs where feasible, that is, if staff or volunteers are working in a particular area the range of weeds may be removed. Elsewhere the focus for weed control will be on species which are threatening the most significant vegetation communities and or species in the reserves. Continuing support will be given to existing volunteer weed control programs to ensure follow up and consolidation of many years effort. Volunteer Landcare programs will be established in other sections of the SCA and the NR as opportunities arise.

Policies

* Native vegetation will be managed to conserve biodiversity, maintain floristic and structural diversity and to conserve species and communities that are threatened, inadequately represented in the reserve system, or of special conservation significance.

* Priority for weed control will be given to those weeds declared noxious in Wyong and Lake Macquarie LGAs; to weeds of national significance; to key threatening processes, and to weed infestations in significant vegetation communities. Other environmental weeds will be progressively controlled, and where practicable removed.

* Weed control plans will be prepared and implemented in cooperation with volunteer Landcare groups and adjoining landowners.

* Recovery plans will be implemented for threatened plant species.

* Endemic plants, propagated from seed collected as close as possible to planting locations, will be used in landscaping, revegetation and rehabilitation work, except where non endemic and/or exotic species are essential for initial stabilisation and present no risk of infestation.

* Scientific research into the distribution and ecology of threatened plant species will continue to be encouraged.

* A more integrated approach will be taken in Bitou Bush control in the reserves, with consideration given to the release of biocontrols, increased spraying and use of burning to encourage native regeneration.

* All development proposals will be preceded by surveys to ensure that impacts on rare or threatened species are minimised.

* The Service will continue to cooperate with other agencies and neighbouring landholders in implementing joint weed control programs.

* Non native and non endemic plantings which are not significant to the community will be removed from all areas of the reserves, including leased and licensed areas.

Actions

* An annual program for weed control, rehabilitation and regeneration programs for both reserves will be prepared.

* A weed survey will be undertaken in the Morisset, Chain Valley Bay and Myuna Bay sections of Lake Macquarie SCA in 2002 and 2003.

* Volunteer weed control and bush regeneration programs at Wangi Point, Awaba Bay and Chain Valley Bay will continue to be supported.

* Volunteer bush regeneration and weed control programs in the state conservation area and nature reserve will be expanded, with priority to support for groups in Chain Valley Bay and at Morisset.

* Short to medium term priorities for weed control are:

  - continued focus on the control of Bitou Bush throughout the SCA and Pulbah Island NR, particularly in the Narrabeen Macquarie Ironbark Forest community at Point Wolstoncroft.

  - removal of W2 weeds from Point Wolstoncroft (Salvinia, Prickly Pear, St Johns Wort and African Boxthorn).

  - removal of Salvinia from Wangi Point.

  - removal of Prickly Pear from Moon Island.

  - control of other W2 and W3 weeds throughout the SCA (Crofton Weed, Pampas, Giant Parramatta Grass and Blackberry).

  - control and removal of Lantana and Morning Glory from the Freshwater Melaleuca Swamp Forest at Awaba Bay.

- control of Privet, Lantana and Crofton Weed in the Permian Macquarie Paperbark Gully forest at Myuna Bay.

* Weed management strategies will be prepared for all areas of the reserves with priority to Morisset and Pulbah Island.

* A research design for monitoring vegetation communities and weed invasion will be developed and promoted as student research projects.

* Surveys for rare plants in the reserves will continue to be undertaken, with priority to completion of the orchid survey in the Chain Valley Bay section of the SCA.

* New development will be excluded from all of the poorly conserved vegetation communities in the reserves, ie. Permian Macquarie Paperbark Gully Forest, Coastal Sandplain Scribbly Gum Forest, Coastal Alluvial Depression Swamp Forest, Narrabeen Macquarie Headland Thicket, Macquarie Melaleuca Scrub-Forest, Alluvial Coastal Intermediate Heath, Macquarie Relic Dry Rainforest, Narrabeen Macquarie Ironbark Forest, Narrabeen Crangan Bay Coastal Forest, Permian Macquarie Grassy Forest, Coastal Alluvial Flat Swamp Forest Complex, Narrabeen Coastal Impeded Sedgeland and Freshwater Melaleuca Swamp Forest.

4.1.3 Native and Introduced Animals

Native Animals

None of the reserves have been systematically surveyed for native animals. Sections of the SCA have been covered by the NPWS Comprehensive Regional Assessment (CRA) surveys conducted in 1996 and 1997 (Point Wolstoncroft and Chain Valley Bay). A survey for small terrestrial mammals (Todd, 1996) was undertaken at Awaba Bay several years ago and some neighbouring lands have been surveyed as part of environmental impact assessments for proposed developments. A student project, involving a fauna survey at Wangi Point and Pulbah Island is underway (Challinor, in prep). Moon Island NR has been subject to bird census on several occasions, including data published by Gray and Gwynne (1974) from visits to the island between 1958 and 1970.

The Lake Macquarie Foreshore Park Proposal stated that over seventy species of birds, at least five native mammals and several reptile species inhabit the area (URGE, 1990). A species list compiled by the Awaba Bay Landcare Group (February 2000) lists approximately seventy native birds. Bird records have also been collected over the past fifteen years for Awaba Bay by the Hunter Bird Observers Club.

Five vulnerable species have been recorded in the SCA (NPWS Atlas of NSW Wildlife): the Pied Oystercatcher (*Haematopus longirostris*), Wallum Froglet (*Crinia tinnula*), Common Bentwing Bat (*Miniopterus schreibersii*) Little Bentwing Bat (*Miniopterus australis*) and the Squirrel Glider (*Petaurus norfolcensis*).

Koalas (*Phascolarctos cinereus*), also listed as vulnerable, were introduced to Pulbah Island, though their numbers and condition are unknown. Koalas also occurred in the Wangi Point section of the SCA until the 1980s. More recent sightings in the SCA have not been confirmed.

One pair of the vulnerable Sooty Oystercatcher (*Haematopus fuliginosus*) has been recorded nesting on Moon Island (Gray and Gwynne, 1974).

In addition to the species recorded in the reserves there are records of endangered or vulnerable species recorded nearby, which are reasonably likely to occur in the SCA and/or on Pulbah Island NR (from Wildlife Atlas). These include the endangered Swift Parrot (*Lathamus discolor*). Vulnerable species include the Black Bittern (*Ixobrychus flavicollis*), Comb-crested Jacana (*Irediparra gallinacea*), Glossy Black-cockatoo (*Calyptorhynchus lathami*), Great Knot (*Calidris tenuirostris*), Masked Owl *(Tyto novaehollandiae*), Osprey (*Pandion haliaetus*), Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*), Yellow-bellied Sheath Tailed Bat (*Saccolaimus flaviventris*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*).

The locally restricted White Breasted Sea Eagle (*Haliaeetus leucogaster*) nests at Awaba Bay, Wangi Point and Pulbah Island. Water rats (*Hydromys chrysogaster*) have recently been reported from the foreshores and waters around Pulbah Island.

The amphibians, reptiles and mammals listed in Appendix the tables below include records from all sources (birds are listed in appendix 3). All are protected – status indicates whether they have additionally been listed as endangered (E) or vulnerable (V) under the *Threatened Species Conservation Act 1995*.

In addition to the Wallum Froglet, other amphibians recorded within the SCA include Leaf Green Tree Frog (*Litoria phyllochroa),* Spotted Grass Frog (*Limnodynastes tasmaniensis),* Bleating Tree Frog (*Litoria dentata)* and Red-backed Toadlet (*Pseudophryne coriacea).*

Introduced Animals

Introduced species are a concern as they damage native vegetation, disturb and kill native animals and may transmit disease to native populations. Introduced species (excluding birds) recorded in the SCA include the Rabbit (*Oryctolagus cuniculus)*, House Mouse (*Mus musculus*), Black Rat (*Rattus rattus)*, Red Fox (*Vulpes vulpes)* and Cat (*Felis catus)*. The proximity of urban development to the state conservation area also means that domestic dogs and pet cats frequently enter the park. There are no recorded bee hives in the reserves. Brown Rats (*Rattus norvegicus*) have been reported on Pulbah Island, although have not been sighted in recent inspections. No introduced animals have been recorded on Moon Island NR.

While domestic dogs do not generally pose a danger to park visitors they are often not controlled and can harass wildlife and visitors: owners rarely pick up their dog's faeces, which is unpleasant for visitors and potentially a source of weed seeds and nutrification. The scent of dogs has the potential to displace native wildlife, especially small and medium sized terrestrial mammals.

Predation by both foxes and feral cats are key threatening processes under the Threatened Species Conservation Act. Foxes have been attributed with causing, or contributing to, the extinction of medium sized terrestrial mammals throughout the mainland, and are known to prey on rare shorebirds, such as Little Terns. Feral and domestic cats are a threat to smaller ground dwelling mammals and birds.

No systematic program to control introduced animals has been undertaken in the SCA or Pulbah Island NR. The Calicivirus, for the control of rabbits, has been released to the south of the SCA. It is unknown whether this has spread to any of the populations around the SCA. The control of foxes on land adjoining urban development has been problematic because of concern over the use of baits in proximity to housing.

Policies

* Priority will be given to the conservation of threatened species and their habitats.

* Priority will be given to the control of introduced animals in the reserves which are identified as key threatening processes.

* Research and survey will be encouraged into the distribution, habitat requirements and ecology of fauna with priority to threatened species or endangered populations within the reserves.

* Recovery plans will be implemented for threatened species which are known or expected to occur within the reserves.

* Native amphibians, reptiles, birds and mammals will not be introduced into the reserves unless under the provisions of an approved recovery plan.

* Domestic pets (including horses) will not be permitted in the reserves with the exception of companion animals.

Actions

* Fauna surveys will be undertaken in the reserves with priority given to Wangi Point and Morisset.

* Vertebrate pest surveys will be undertaken in the SCA with priority to Chain Valley Bay.

* A research design for survey and monitoring introduced animals in Lake Macquarie SCA will be prepared and components will be promoted as student research projects.

* Species profiles (distribution/habitat requirements) and management guidelines will progressively be prepared for wildlife in the reserves.

* Vertebrate pest control plans, with annual control targets, will be implemented for the SCA, with priority to fox control, in cooperation with LMCC, Wyong Shire Council and neighbouring landowners.

* The Service will seek the cooperation of neighbours and visitors to prevent access to the SCA by domestic dogs, cats and horses.

4.1.4 Fire Management

Fire has great capacity to directly affect the conservation of species, habitats and the maintenance of biodiversity. Appropriate fire regimes are necessary to conserve habitats and populations of species. Conversely, inappropriate use of fire can damage habitats and cause local depletion or extinction of species.

Under the *Rural Fires Act 1997*, the Service is recognised along with the Rural Fire Service, State Forests of NSW and the NSW Fire Brigades, as a fire authority. The Service therefore has shared responsibilities for the co-ordination of bushfire suppression, mitigation and prevention activities in accordance with the principles of ecologically sustainable development within rural fire districts. The Service, as a land manager, also has a statutory obligation to prevent the occurrence of wildfire and to minimise the spread of wildfires within the park and reserves. The Service works closely with the Rural Fire Service and the NSW Fire Brigades in this regard.

Section 50 of the Rural Fires Act 1997 provides for the establishment of District Bush Fire Management Committees (DBFMCs) with the task of developing and co-ordinating co-operative fire management between fire authorities. The NPWS is a member of the Lake Macquarie and Wyong Bush Fire Management Committees which are responsible for the development of both co-operative fire-fighting and management programs for the reduction of bush fire hazards.

Under Section 52 of the Rural Fires Act 1997, each Bush Fire Management Committee is to prepare two kinds of bush fire management plans for the rural fire district: a plan of operations and a bush fire risk management plan.

The primary objectives for fire management in NPWS reserves are:

- to prevent unplanned bushfires in NPWS reserves;
- to suppress unplanned bushfires occurring in NPWS reserves;
- to minimise the potential for spread of bushfires on, from, or into NPWS reserves;
- to protect people and property on, or immediately adjacent to, NPWS reserves, from bushfires;
- to manage bushfires to avoid the extinction of all species which are known to occur naturally within NPWS reserves;
- to protect Aboriginal sites, historic places and culturally significant features in NPWS reserves from damage by bushfires; and
- to promote effective and efficient use of regional bushfire fighting resources through co-operative planning and operational arrangements.

The NPWS aims to meet its fire management and conservation responsibilities under the National Parks and Wildlife Act 1974 by:

- preparing fire management plans for all fire prone reserves;
- ensuring that fire management strategies will protect natural and cultural heritage;
- promoting appropriate fire regimes in reserves for the conservation of native plant and animal communities; and
- engaging in research for the conservation of native plant and animal communities.

Detailed fire history records for Lake Macquarie SCA, Pulbah Island NR and Moon Island NR are not available. No fires are known or likely to have occurred on Moon Island due to limited vegetation coverage.

The vast majority of wildfires in the reserves appear to be caused by arson. Most fires are lit along road sides, fire trails and walking tracks. The immediate proximity of residential development to the reserve requires that special consideration be given to the protection of life and property from fire.

The natural fire regime of the reserves is unknown. However, Lake Macquarie SCA and Pulbah Island NR are relatively small protected areas containing a wide variety of plant communities that are affected by fire in various ways. The reserves' (biological) isolation by urban and other development and water means that populations of plants and animals dependent on migration for recruitment following fire are particularly vulnerable to adverse impacts of large uncontrolled fires.

The correct management of fire is essential to the conservation of native plant and animal species. Both the long and short term effects of fire on native flora and fauna, including the biota of the surface and sub-surface soil zone, are largely

dependent upon frequency, intensity, season of occurrence and spatial variability of bushfires.

Contemporary ecological research into fire prone ecosystems, such as those in Lake Macquarie SCA and Pulbah Island NR, has established broad principles about the fire regimes needed to avoid the extinction of species and conserve biodiversity:

- Groups of plant and animal species which constitute an ecosystem respond similarly to fire according to the characteristics of their life-history. It is not necessary to specify fire regimes for the conservation of every species. Rather, fire regimes for groups of species or an ecosystem are required;

- Animals and plants are interrelated. Plants form an important component of the habitat of animals. Fire management must consider this important interaction; and

- A diversity of fire regimes is needed to maintain natural diversity. Accordingly, the management of fire should aim to provide a pattern of fires of high, moderate and low intensity, frequency and extent. Extinctions are most likely when fire regimes of relatively fixed intensity, frequency and extent prevail.

Scientific understanding of the fire requirements for plant communities is generally more advanced than for animal communities, although recently published research demonstrates that the conservation of many animal species also depends upon a mix of fire regimes including occasional high intensity fires. Regular and low intensity fires have an unacceptable impact on habitat for native animals, particularly on ground plants and undergrowth.

With these general principles as a basis, fire management guidelines have been developed for the reserves which define fire regime thresholds for several major groups of plant communities. If these thresholds are exceeded or not met, the decline and/or local extinction of plant species and habitats may be expected.

In due course this should lead to a mosaic of habitats of different age classes of intensity and frequency of fire which will be of high value for the protection of native plants and animals.

A draft Reserve Fire Management Plan has been prepared for the reserves. It provides detailed operational guidelines for the management of fire to protect life, property, natural and cultural heritage.

Policies

* Fire management will aim to protect life and property within and adjacent to Lake Macquarie SCA and Pulbah Island NR and to achieve the earliest practical control of fires on NPWS estate whilst conserving the biodiversity of the reserves.

* The management of fire in the reserves will be in accordance with the reserve fire management plan for Lake Macquarie SCA and Pulbah Island NR, when prepared, and the Wyong and Lake Macquarie Bush Fire Risk Management Plans and Plans of Operations.

* The effective and efficient use of bushfire fighting resources and expertise through co-operative arrangements will be promoted.

* The NPWS will continue to work cooperatively with other fire management authorities and the community in strategic planning for the protection of life and property and natural and cultural heritage.

* Community understanding of the role and management of fire within NPWS areas will be promoted.

* The cooperation of all relevant authorities, neighbours and visitors will be sought in controlling the occurrence and extent of wildfires.

* The NPWS Central Coast Hunter Range Region will maintain a fire management information system to assist in the identification of bushfire zones, fire hazardous areas, trends in fire occurrence, assets at risk and sensitive environments, ecosystems and species.

* Fire regimes in Lake Macquarie SCA and Pulbah Island NR will be managed to:

  – Stay within the known fire frequency limits for maintaining species habitat and diversity, avoid local extinctions of native plant and animal species and enhance the conservation of threatened native plant and animal species.

  – Protect natural assets, including fire sensitive habitats.

  – Protect cultural assets and visitor facilities.

Actions

* A detailed fire history of Lake Macquarie SCA and Pulbah Island NR will be developed and maintained for fire management planning.

* A fire management plan will be prepared for Lake Macquarie SCA and Pulbah Island NR by 2005. In the interim, fire will be managed in line with the fire regime thresholds for the major plant communities identified in the draft fire management plan for the reserves. The NPWS will place the fire management plan on exhibition for public comment before its final adoption.

* The NPWS will continue to assist with the preparation, implementation and review of the Wyong and Lake Macquarie Bush Fire Risk Management Plans and Plans of Operations.

* Information on fuel characteristics and fire hazard will be maintained and upgraded.

* Hazard reduction works will be conducted as specified in the reserve fire management plan and bush fire risk management plans.

* Wherever practicable, trails used for fire management and other purposes will be maintained by grading and slashing and will be relocated or realigned where necessary for fire management and erosion control purposes.

* Research into fire behaviour, fire hazard and risk assessment, and the impact of fire on the reserves' plant and animal communities will be encouraged.

* Fire awareness education will be promoted to neighbours and reserve visitors.

4.2 CULTURAL HERITAGE

4.2.1 Aboriginal Sites and Places

Information about the traditional and early historical Aboriginal history of the area derives from two main sources: archaeological evidence and records made after 1825 by the Rev Lance Threlkeld who was a missionary in the region for 15 years (Gunson, 1974). Most of the information below is based on Threlkeld's accounts, or what can be inferred from archaeological investigation.

The Awabakal people were the original inhabitants of the area, occupying a coastal territory between Tuggerah Lakes and the Hunter River. People lived mainly in huts large enough for six to eight people, with fires built at the entrance. Settlements of eight or nine huts were recorded by early settlers.

Not a great deal is known of the traditions and religion of the Awabakal because in the early years of settlement and dispossession no concerted effort was made to record their beliefs. Threlkeld is the source of the earliest records, but he made his observations more than a generation after the European settlement of New South Wales had introduced diseases which decimated Aboriginal populations on the coast, even ahead of the occupation of their territory by the Europeans.

On the east coast of NSW people believed that a sky god called Baiami created the land and the people and gave them their laws. Baiami was believed to be present during ceremonies and rituals. The Awabakal people consider Pulbah Island sacred and called it Boroyirong. The lake and island were believed to be created by the emergence from underground of the demon or monster Rogoyarran, who was the protector of the island. His arrival was heralded by tea tree bark floating to the surface of the water. Rogoyarran would then appear and overturn canoes and attack and eat people (Gunson, 1974).

People on the Central Coast, Lake Macquarie and the Hunter had similar rituals and ceremonies and joint ceremonies were sometimes held, with accounts of large gatherings on the coast in the Tuggerah Lakes - Lake Macquarie area. Ceremonies were held in earthen rings or circles, sometimes marked by carvings on nearby trees. Every three or four years ceremonies were held to initiate groups of young men into adulthood (Gunson, 1974). The initiation rituals or rites for young women were not recorded by Threlkeld.

The area was rich in food. Plant foods included fruit (cabbage palm, macrozamia, lillypilly, geebung), seeds (grasses and acacias), leaves (from grass trees, rushes and sedges), roots/tubers (of orchids and bracken fern), yams and flower nectar (from banksias, grass trees etc). Shell fish, including pipis, cockles, mussels, whelks and oysters, were collected from rock platforms, the lake foreshore and beaches. Fish were caught in rivers and lakes with lines or spears, or trapped in weirs built at the entrance of tidal channels.

Threlkeld reported Awabakal people visiting Moon Island, at the entrance to Lake Macquarie, to collect mutton-bird chicks and eggs (Gunson, 1974). Wallabies, kangaroos, possums, bandicoots, wombats, fruit bats, rats, birds, snakes and lizards were all hunted. Insects were also eaten and there is an account of wild dog being consumed. Stranded whales were "…quite a feast, and messengers are dispatched to all the neighbouring tribes, who assemble and feast upon the monster of the deep so long as the treat lasts." (Gunson 1974).

Archaeological investigation of Aboriginal sites in the wider region (Loggers Shelter, Mangrove Creek) indicates that people were probably living on the Central Coast from about 11,000 years ago. The majority of recorded sites along the Central

Coast (north of the Hawkesbury sandstone country) are shell midden deposits. Most of the recorded middens have a small range of species with no other associated evidence. They have nearly all been disturbed by recent land uses. Some deeper middens, associated with burials, have been recorded at Swansea and south of Caves Beach. Other sites found in the region include axe grinding grooves, on comparatively smooth rock outcrops, and artefact scatters with stone tools found on the surface or in shallow deposits.

Although there are historical reports of tree carving and scarring, resulting from bark removal for tool production, the survival of such sites is very rare. Because of the geology of the reserves, shelter formation is fairly uncommon and in conglomerate formations art is unlikely to occur on the erodable and uneven surfaces.

Lake Macquarie has numerous middens on its margins and they are the most common recorded archaeological evidence in the reserves, with 12 having been recorded from the foreshores of Chain Valley Bay, Wangi Point, Awaba Bay and Pulbah Island. There are also two recorded rock shelters and several axe grinding groove sites.

None of the reserves have been systematically surveyed for Aboriginal sites and places. In areas that have been undisturbed by more recent land uses, additional sites are expected to occur.

Three land councils represent Aboriginal interests in the areas covered by this plan: Bahtabah Local Aboriginal Land Council covers Pulbah and Moon Islands; Darkinjung the Point Wolstoncroft and Chain Valley Bay sections of the SCA, and Koompahtoo the other four sections of the SCA.

The NPWS recognises the right of Aboriginal people to make decisions about their heritage. The NPWS will ensure that people are fully consulted and have input to works with potential to impact on Aboriginal cultural values, Aboriginal heritage research and the development and implementation of programs for interpretation or promotion of Aboriginal cultural heritage or history in the reserves.

Policies

* Aboriginal sites and places in the reserves will be managed in consultation with the local Aboriginal community.

* Aboriginal sites and places in the reserves will be conserved and managed to minimise natural deterioration and to prevent impacts from management and visitor activities.

* Management activities and works with the potential to impact on Aboriginal sites will be preceded by an Aboriginal heritage assessment undertaken in consultation with the relevant land councils.

* Involvement of Aboriginal people in interpretation of the reserves' Aboriginal heritage will be encouraged.

* Research into the Aboriginal heritage of the reserves will be encouraged.

* Newly discovered sites will be recorded in the Service's Aboriginal site register and the condition of known sites will be monitored.

Actions

* Unsurveyed sections of the reserves will progressively be surveyed, with priority to completion of a survey of Pulbah Island, and to sections of the SCA where there is potential for impact from management or visitor activities.

* Foreshore middens on Pulbah Island will be stabilised.

* Aboriginal people will be invited to have input to any NPWS Discovery programs which interpret the Aboriginal history or heritage of the reserves.

* A monitoring program to track the condition of the sites recorded in the SCA and NR will be developed and implemented, with priority to sites recorded on Pulbah Island.

4.2.2 Historic Places

Historical Background

In July 1800, Captain William Reid left Sydney on the schooner “Martha” to load coal from the Hunter River at Newcastle. Approximately 12 miles south of his intended destination he mistook the entrance to the then unnamed lake for the entrance to Newcastle Harbour. He mistook Moon Island for Nobbys, off Newcastle. He gathered a cargo of coal and returned to Sydney. For nearly 20 years the location of his navigational error was known as “Reid’s Mistake” (Clouten, 1967).

In 1822, Lieutenant Percy Simpson, a former military officer, was granted two adjoining areas of 2,000 acres each, on the western side of the lake, which he worked with convict labour. He named the property “Koorumbung” and it became the first permanent European settlement in the region. (Clouten, 1967).

The Rev Threlkeld was one of the other early non-Aboriginal settlers in the region and the name Lake Macquarie was first recorded in correspondence written by him in 1826. On behalf of the London Missionary Society he established a mission on Lake Macquarie near Belmont in 1825. He moved to a new land grant on the western side of the lake near Toronto in 1831 to continue his missionary work. He seems to have had good relations with the Awabakal people and was a sympathetic observer and recorder, often acting as an interpreter for Aboriginal people on trial (Gunson 1974).

Settlement of Newcastle and Lake Macquarie in the 1820s was spurred on by the success of the timber industry and the first substantial settlements grew up at Cooranbong, Dora Creek and Eraring.

The early 1830’s saw the greatest influx of new ‘opportunists’. Bushrangers, escaped convicts and persons of dubious character travelled along the main tracks traversing the western side of the lake, stealing cattle and livestock from scattered farms and robbing travellers.

Cedar ‘gangs’ operated on the western side of the lake. By the 1830s restrictive conditional licenses were required to fell cedar which had been depleted around Sydney. Timber was taken by bullock team, or floated down Dora Creek, where it was shipped to loading points on the Lake. A pilot station was established at the entrance to the lake to assist vessels to navigate the bar and became the impetus for the development of Swansea.

By 1875 Dora Creek was the principal centre of population and trade on Lake Macquarie, however the village declined once the Newcastle rail link was completed in 1889 and demand for sleepers dried up. Soon after, water transport on the lake also collapsed as it could not compete with the nearby railway.

Historical evidence in the SCA and NR

None of the reserves have been surveyed for physical evidence of non-Aboriginal use or occupation. There has been little recording or assessment of the historic places that are found in the reserves. No historic places or evidence of them has been found on Moon Island.

Wangi Point

The Wangi Point section of the SCA was part of the original land grant of 1842 to Edward Gostwyck Cory. He did little to develop or clear the land and it became a haunt of cattle thieves, who were able to pen cattle with minimal fencing effort on the point. (South-Lakes Christian Women's Group, 1987)

In 1897, David Watkins, a former coal miner, entered the political arena as MLA for Wallsend. He was later instrumental in establishing Wangi Point as a recreation reserve (proclaimed on 25th May, 1897). A large timber and iron rotunda, which was used as a shelter shed and venue for dances, was built above the cove to the south of the present Wangi Point Tourist Park (South-Lakes Christian Women's Group, 1987).

A ferry service between Wangi Point and Toronto led to a growth in tourism in the 1910s and 1920s. There were swimming enclosures and guesthouse and a tollgate was erected near Lakeview where visitors were charged a 6 pence entry fee. After subdivision, Wangi Point also became a holiday destination, particularly for miners from the Cessnock coalfields. It was a popular tent city during December and January when the mines closed for Christmas (Lake Macquarie City Council 1985).

The use of Wangi Point for holidaying continues via the Wangi Point Tourist Park which provides van, cabin and tent camping in this part of the SCA. Evidence of other uses of this part of the SCA have not been recorded. (South-Lakes Christian Women's Group, 1987)

Awaba Bay

In the Awaba Bay section there are a number of features relating to settlement and use of the land prior to its gazettal as an SCA. The dwellings and outbuildings of Hepplewhite's permissive occupancy, constructed circa 1900 (Hepplewhite, R., *pers. comm.,* 2000), are on part of the original land grant made to Thomas Mitchell in 1830 (Clouten, 1967). Alexander's permissive occupancy, to the north of Hepplewhite's, had a house and five outbuildings of 1930s or 1940s construction (Hepplewhite, R., *pers. comm*., 2000). These were demolished in March 2000 due to their vandalised and poor condition. Archaeological deposits are expected to be associated with both house sites.

The footings of a jetty (age unknown) are located on the foreshore north of Hepplewhite's and Alexander's. A quarry (age unknown) is associated with this jetty site. Further north, holes (ages unknown) thought to be associated with coal extraction may be found. Timber was no doubt extracted from the area when it was part of the Quigley estate, though no physical evidence of this has been recorded (Clouten, 1967).

Myuna Bay

In the Myuna Bay section of the SCA, there are wharves and inlets associated with the decommissioned Wangi Power Station. Construction of the station commenced after World War II and was completed in 1958. The first structures were built in the early1950s. No other historical evidence has been recorded in this part of the SCA (Lake Macquarie Council, 1985).

Morisset

In 1900, 1300 acres on the western side of the lake were reserved for the construction of a psychiatric hospital. Clearing of the site commenced in 1906 and tents initially provided accommodation for patients and staff. The first building was completed in 1908 (the recreation hall) and the first ward was opened in 1909.

Land that was part of the original hospital site to the north, east and west of the main complex of buildings has now been transferred to the SCA. It includes several structures relating to hospital use including a wharf (in very poor condition), an enclosed swimming area (also in poor condition) garden features and several amenities. Although the hospital complex is considered to be a place of high cultural significance, the features in the SCA do not have anything more than associative value.

Chain Valley Bay

The Chain Valley Bay section of the SCA has a similar land use history to Awaba Bay, having been used for timber getting and coal extraction. The area is thought to have been part of a 500 acre land grant made to Richard Cape in 1825 for use as a cattle station. In 1835, John Moore sought and gained title to the land after Richard Cape temporarily left the colony (D. Hartley, *pers comm*., 2001).

James Taffe first occupied the area in the 1950s. William Forster who had an old property on Point Wolstoncroft in the preceding decade formerly owned land in the area known as the Chain Valley Plain (Clouten, 1967:120). No physical evidence of this history has yet been recorded or assessed.

Point Wolstoncroft

Little is recorded about early use of Point Wolstoncroft for timber getting or mining. Some of the Point Wolstoncroft section of the SCA was apparently part of the same land grant made to Richard Cape in 1825 which covered the Chain Valley Bay area (South-Lakes Christian Women's Group, 1987; D. Hartley, *pers comm*., 2001). In 1880, all of Point Wolstoncroft, to the southern boundary of Tiembula Creek, was granted as a public reserve (D. Hartley, *pers comm*., 2001).

No evidence of uses of the area pre-dating the development of the Sport and Recreation facility has been recorded.

Pulbah Island

In the early years of settlement around Lake Macquarie, Pulbah Island was used for recreation: picnics, camping, hunting and fishing. In the 1870s rabbits were introduced for game and saw mills were established, with spotted gum and ironbark taken for shipbuilding. Shell midden deposits were mined for lime.

In 1917, the Dalley Branch of the Australasian Society of Patriots was formed. They developed a vision for Pulbah Island as a microcosm of an unspoiled Australia and planned to stock it with native plants and animals. In 1920, the island was declared

as a reserve for flora and fauna so that "…future generations of Australians may have an opportunity of gazing upon specimens of that interesting and varied fauna which so delighted Captain Cook, Sir Joseph Banks and their gallant comrades." (Hartley, 1998).

There was incongruity between the vision and its realisation. People continued to visit the island to hunt while the Trust's lobbying for funding and support had varied success. Trees were planted as food for birds and animals, including figs, cedars, kurrajongs and "berry" trees. Ring-tailed possums and black possums were introduced, as were koalas from Victoria. With the increase in the fauna population the Trust found it necessary to provide artificial water supplies. The Trust appointed a caretaker in 1925 and two years later requested the construction of dams on the northern side of the island. The island was again stocked with possums, more koalas, this time from Queensland, and grey kangaroos from Morisset. "Improvements" made by the Trust included a wharf and picnic shelter shed, construction of a cottage for the caretaker, fences and pens for some of the introduced birds (Hartley, 1998).

Overstocking was an issue by 1933 and the Trust cleared more native vegetation to provide pasture for kangaroos. In a drought in 1940, a windmill was installed and once more improved conditions led to an increase in numbers. The management of the island as a fauna reserve or zoo fell into abeyance during World War II and structures on the island were neglected and vandalised.

Plans for the transfer of the responsibility of the island to a variety of organisations limped along until the establishment of the National Parks and Wildlife Service. Pulbah Island was declared a Nature Reserve in 1970. Despite this, another introduction, this time of 36 Parma Wallabies, took place in 1972. The animals either starved or were shot over the next year or so (Hartley, 1998).

There is a fair amount of evidence of prior use surviving on the island, including footings and remnants of concrete structures, which has not been formally recorded.

Policies

* Any significant historic heritage within the reserves will be conserved in accordance with the Burra Charter of Australia ICOMOS.

* Physical evidence of timber, coal and gravel extraction will not be removed or rehabilitated, unless contributing to erosion, but will not be actively conserved.

* Buildings will not be removed from the SCA without prior assessment of their cultural significance.

* Works with the potential to affect significant historical archaeological evidence will be preceded by environmental impact assessment.

* Research into the history of the reserves will be encouraged.

Actions

* Chain Valley Bay and Point Wolstoncroft are the least known sections of the SCA. Research into their history and associated physical evidence will be promoted as student projects.

* Known historic sites at Awaba Bay, Myuna Bay and Pulbah Island will be systematically recorded and entered on the Heritage Register.

4.3 USE OF THE STATE CONSERVATION AREA AND NATURE RESERVES

Lake Macquarie SCA, Pulbah Island NR and Moon Island NR will be managed to ensure that their use, whether by the general public, special interest groups, the NPWS or other authorities is consistent with the *National Parks and Wildlife Act 1974* and the objectives and policies of this plan of management.

The uses that are appropriate in Lake Macquarie SCA are:
- education and promotion of the SCA;
- conservation of the natural and cultural heritage of the reserve;
- nature based recreation;
- scientific research; and
- management operations by the NPWS and other authorities.

The uses of Pulbah Island NR that are appropriate include:
- education and promotion of the nature reserve's values;
- conservation of the natural and cultural heritage of the island;
- research; and
- management operations by the NPWS.

Appropriate uses of Moon Island NR include:
- education and promotion of the nature reserve's values;
- conservation of the natural and cultural heritage of the island;
- research; and
- management operations by the NPWS.

The extent to which these uses are suitable in the reserves is considered in the following sections.

4.3.1 Promotion and Environmental Education

4.3.1.1 Lake Macquarie SCA

Lake Macquarie SCA provides valuable educational opportunities with its natural features and its accessibility by a large population from Newcastle, Lake Macquarie, the Central Coast and the Lower Hunter Valley. The reserve has had little use as an educational resource. It is an objective of this plan to encourage educational programs about the values and management of urban bushland in conjunction with local educational, research and community organisations such as the University of Newcastle, TAFE and Landcare.

Provision of opportunities for community groups and individuals to participate in the management of the reserve is another objective of this plan.

There is limited promotion of the SCA in the local and wider community. People visit the reserve with a diverse range of expectations and understanding of appropriate behaviour. To improve understanding of the importance of the reserve and to encourage support and a sense of ownership, promotion of the reserve will be undertaken, based on the key values and importance of the SCA including:
- the scenic landscape;
- the diversity and importance of native plant communities;
- threatened species and their habitats;
- appropriate recreation; and
- educational opportunities.

Policies

* Lake Macquarie SCA will be promoted to the general community with emphasis on scenic and landscape values, vegetation communities and nature based recreational opportunities.

* The NPWS will liaise with education groups to promote research and education opportunities.

* Community involvement in management of the reserve through Landcare and Bushcare activities will be promoted and supported.

* The purpose of management programs for the control of fire and pest species will be promoted in the local community.

* The *Discovery* program will be promoted in the SCA with a range of activities relating to key values of the reserve and the purpose of management programs.

* Signs will be rationalised and upgraded in line with NPWS design standards, providing guidance on acceptable activities and information about facilities and attractions.

* Signs and brochures will be provided to interpret features of interest and assist with the orientation of visitors to the SCA.

* The NPWS will work in conjunction with support tourism organisations for the promotion of the values and sustainable use of Lake Macquarie SCA.

* Interpretive displays will progressively be installed at key visitor contact points throughout Lake Macquarie SCA.

Actions

* Bays will be provided throughout the reserve with information about local attractions and suitable activities, with priority to Awaba Bay, Wangi Point and Chain Valley Bay.

* Management activities will be promoted by means of fliers, pamphlets, press releases, signs etc at key times of the year (eg when hazard reductions are planned).

* Signs will be upgraded with priority to park identification and regulatory signs at Awaba Bay, Wangi Point and Chain Valley Bay. Signs will be erected and constructed with consideration for the high level of vandalism experienced in the area.

* The Region's *Discovery* program will be expanded to include activities in the SCA, with emphasis, initially, on the vegetation and threatened species in Chain Valley Bay.

* Local media releases about volunteer activities and opportunities for local community involvement will be prepared and circulated.

* Promotion of Landcare and Bushcare groups in the SCA will be undertaken by developing a display for local shows and events and regular distribution of fliers and / or newsletters.

* The NPWS will liaise with and provide brochures and *Discovery* program information to local tourist information centres.

4.3.1.2 Pulbah Island NR and Moon Island NR

These island nature reserves have limited potential for education because of inaccessibility. People visit Pulbah Island on a regular basis and Moon Island infrequently, but they are sometimes unaware that the islands are nature reserves and that fires, dogs and camping are not permitted. To increase community understanding of the importance of the reserves and suitable use, programs need to be implemented to encourage support and care for the islands. These will be based on promotion of:

- the scenic landscape and natural setting.
- the diversity and importance of native plant communities on Pulbah Island.
- the Aboriginal significance of Pulbah Island.
- the importance of Moon Island as a seabird roosting and nesting site.

Policies

* The NPWS will develop educational information about the natural heritage and Aboriginal values of Pulbah Island.

* The NPWS will not actively promote public access to Pulbah Island NR and Moon Island NR and will seek the cooperation of other authorities in promoting this approach.

Actions

* A brochure will be developed for Pulbah Island NR emphasising vegetation and Aboriginal heritage significance and appropriate uses. This brochure will be distributed to the public through NPWS offices, Visitor Information Centres and local council.

4.3.2 Access and Recreation

4.3.2.1 Lake Macquarie SCA

Lake Macquarie SCA contributes to a diversity of recreational opportunities available in Newcastle, Lake Macquarie and the Central Coast, providing passive recreation in a natural bushland setting. The SCA provides alternative outdoor recreation opportunities to those offered by the commercial and local government recreation and tourism sector.

An estimate of the number of visitors to the reserve is not available, however it appears that the majority are local residents who value their section of the reserve as a place to escape from the urban environment and for the contribution it makes to the beauty of Lake Macquarie.

Vehicle Access – Awaba Bay

The Awaba Bay portion of the SCA has been closed to vehicles for several years. This closure has significantly reduced the incidence of rubbish and car dumping and provides protection for the natural, cultural and recreational values of the area. Four trails are maintained in this section and are adequate for management purposes (see map 1). No formal car parking is provided for visitors to Awaba Bay. Research into the requirement for parking (including location/s and numbers) will be undertaken.

Vehicle Access – Wangi Point

Access to Wangi Point is provided from Reserve Road to the south and Watkins Road to the north (see map 2). An access road through the reserve and the Wangi Point Tourist Park links these two public roads. This access is principally for the Tourist Park and for locals and visitors who use the boat ramp, jetty and foreshore picnic facilities. Sections of this road are in poor condition. At night the Tourist Park experiences security problems due to this access road, however the local community has expressed significant opposition to any closure of this road to the public. It is suggested that appropriate measures be implemented within the Tourist Park to prevent unauthorised vehicle access to internal roads, allowing the access road through the Tourist Park to remain open to the public at all times.

Vehicles have not been permitted on the southern and northern parts of Wangi Point for several years and this has again reduced the amount of rubbish and car dumping in the area. It has also allowed rehabilitation and protection of the natural and recreational values of the area. A management trail in the south of the reserve (Map 2) provides limited access to the point. Hunter Water uses another management trail located in the north of the reserve (Map 2) under an easement, for access to a pump station.

Vehicle Access – Myuna Bay

Unrestricted public vehicle access is available at Myuna Bay and as a result there is frequent night time dumping of household waste, garden waste, furniture and white goods. Vandalism and arson also occur in this area fairly frequently. It is considered that two trails are required for management purposes. The existing trail along the foreshore will be closed and rehabilitated. The other two trails will be maintained to a standard suitable for management (Map 3).

It is proposed to close this section of the park to public vehicle access to assist in the management of rubbish dumping and vandalism. Pedestrians will be able to obtain access to the foreshore from Summerhill Drive, Eucalypt Close or Beach Road. This will involve a walk of between 20 and 100 metres. Formalisation of access will require negotiation with Council regarding use of the road reserve. A car park will be provided off Summerhill Drive, following research into visitor numbers to determine car parking requirements.

Vehicle Access – Morisset

Access to the Morisset section of the SCA is via Silky Oak Drive (off Morisset Park Road) and Acacia Avenue (off Wangi Road, Morisset) (Map 4), which also provide access to the hospital and to the foreshore adjoining the hospital grounds to the east.

The northern section of the Morisset portion of the reserve has been closed to public vehicle access for several years and will remain so. The road to Woods Point will be maintained as a management trail. Visitors will be able to walk to Woods Point from Silky Oak Drive, or go by boat.

The southern section of the reserve contains several trails used by the public. These trails do not provide access to facilities and it is anticipated that several will be closed to public vehicle access and maintained for fire management. Map 4 indicates management trails to be maintained in the reserve.

Vehicle Access – Chain Valley Bay

Chain Valley Bay is accessed via Chain Valley Bay Road and Kanangra Drive. A network of trails, many of which are severely eroded and unnecessary for management, exists in this section. The northern portion of Chain Valley Bay Road (bounded by the SCA) has been closed to public vehicle access for several years. Despite gating, unauthorised vehicle access is still a major problem in the area, with track erosion, rubbish dumping, car dumping and car arson occurring on a regular basis. This section of the reserve contains numerous orchids and other significant plant species, some of which are rare and endangered. Unauthorised vehicle access has been identified as a threat to at least one rare species of orchid in the reserve (Riley and Eygelshoven, 2000:7).

The Chain Valley Bay portion of the reserve will remain closed to public vehicle access and some sections will be fenced to protect the conservation and recreational values of the area. Parking facilities will be provided at the northern end of Chain Valley Bay Road. Map 5 indicates those trails which will be maintained for management purposes.

Vehicle Access – Point Wolstoncroft

Access to Point Wolstoncroft is via Kanangra Drive. Public access is restricted to authorised visitors as the Department of Sport and Recreation operates the area as a Sport and Recreation Centre. The vehicle trail north of the Sport and Recreation Centre, which leads to Point Wolstoncroft, will be closed to the public and maintained as a fire trail. Existing trails to picnic areas on the point will be maintained for management purposes (Map 6).

Walking Tracks

A walking track is being developed along the foreshore of the lake at Awaba Bay to provide pedestrian access from Bolton Point to Marmong Point. Interpretive signs, a lookout and picnic facilities will be installed along the track route.

A system of walking tracks is in place at Wangi Point and will be maintained and upgraded to reduce erosion. Interpretive signs will be installed and existing track route signs and markers upgraded.

The local community has expressed an interest in the development of a walking track at Chain Valley Bay interpreting the area's flora and fauna. Concepts for the development of a walk in this portion of the SCA will be investigated in consultation with the local community. The walking track system is shown on maps 1 to 6.

Camping and Accommodation

Camping, van and cabin accommodation is available at the Wangi Point Tourist Park and will continue to be provided under the lease with Lake Macquarie City Council.

The Chain Valley Bay Van Village also provides camping adjacent to, and in a small section of, the SCA at Chain Valley Bay. Gazettal of the reserve included a section of the Van Village which had been used for camping for a number of years. This is currently an encroachment into the reserve, which needs to be formalised by a lease or licence agreement.

Overnight accommodation is provided at the Department of Sport and Recreation's facilities at Point Wolstoncroft. This arrangement also needs to be formalised in a lease between the NPWS and the Department.

Until recently camping was provided at Woods Point, in the Morisset portion of Lake Macquarie SCA, by the Department of Health. The Department has decided to withdraw from its management of the camping area. The toilet facilities are considered inadequate. There are two toilets in an area that has been booked out for groups of up to 40 people. The toilets require regular filling by water tanker which the hospital has been able to manage due to their close proximity to the area. The toilets are located close to the lakeshore and need to be closed or upgraded to ensure that the aging septic system complies with Environment Protection Authority (EPA) guidelines. The main clientele of the Woods Point camping area appears to have been Department of Health staff and families (Alan Walker, 2000, pers com).

Considering existing and projected resource levels, the capital and management requirements of providing camping at Woods Point cannot be met by the NPWS. Consideration will be given to replacing the toilets at Woods Point. If the toilets are replaced, opportunities for foot and boat based camping may be explored.

Illegal camping is known to occur at Pulbah Island, Awaba Bay, Myuna Bay and Point Wolstoncroft. A public education program will be implemented and signs will be installed indicating that camping is not allowed in these areas.

Lookouts

The SCA has many vantage points with scenic views across the lake. Two of the most popular are found at Wangi Point and Awaba Bay. Lookouts will be provided at both locations, with facilities including seats. The proposed lookouts are shown on maps 1 and 2.

Day Use Areas

There are no visitor facilities (other than walking tracks) at Awaba Bay, however it is anticipated that two areas, with seating, will be developed in conjunction with the foreshore walk (Map 1). Two such areas are maintained at Wangi Point, with BBQs and seating on the foreshore near the Tourist Park, and seating at the southern end of Reserve Road (Map 2). The rubbish bins at Myuna Bay will be retained and seating will be provided (Map 3). Safety railings on the old power station structures will be upgraded in consultation with Pacific Power.

The facilities that have been installed at Woods Point in the Morisset portion (Map 4) are in generally poor condition and need to be reviewed to assess whether they meet NPWS standards and the requirements of day use visitors.

Additional facilities will not be provided at Point Wolstoncroft, as the Department of Sport and Recreation already provides a range of facilities (Map 6).

Chain Valley Bay seems not to receive a large number of visitors, and as locals have expressed a preference for a “natural bush experience”, no visitor facilities, other than improved walking tracks and signs, are planned in this section (Map 5).

Toilets

An environmental impact assessment of the pit toilets in Hepplewhite’s permissive occupancy, Awaba Bay, and at Point Wolstoncroft will be undertaken. The issues regarding the septic toilets at Woods Point have been outlined above. Additional toilets are not planned for the reserve.

Radio Stations

There is one radio station located in an old house in the far northwestern corner of the Morisset section of the SCA. This use pre-dates the establishment of the reserve and although unusual, it is not inconsistent with the recreational, natural or cultural values of that part of the reserve, as the building is located in a highly modified landscape.

Domestic Pets

In keeping with NPWS policy and regulation, domestic pets will not be permitted in the SCA. Horse riding is only permitted on public roads and has not been permitted in the state conservation area for some years.

Policies

* The Service will encourage sustainable and minimal impact recreational use in the SCA.
* Information on appropriate recreational uses of the reserve will be prepared.
* Interpretation will be provided on all walking tracks that are part of the formal walking track system.
* All access tracks which are not part of the public access system and are not required for management purposes will be closed and rehabilitated.
* Parking will be provided in strategic locations as determined by an assessment of visitor use.
* All walks will be signposted and will display the distance and time taken to complete the walk.
* Visitors will be encouraged to remove their own rubbish from the park.
* Domestic pets and horses will not be permitted in any part of the SCA.
* Consent of the Regional Manager will be required for organised or group activities.

Actions

* A visitor survey will be conducted in the SCA to determine facility requirements, with priority to the Myuna Bay, Wangi Point, Awaba Bay and Chain Valley Bay sections.
* Landscaping with endemic vegetation will be undertaken to provide shade and to improve the aesthetics of camping, picnic and day use areas, with priority to Myuna Bay and Awaba Bay.
* A parking strategy will be developed for Awaba Bay, Wangi Point, Myuna Bay, Morisset and Chain Valley Bay following an assessment of visitor use.
* The trail between the jetty structure and old power station inlet in the Myuna Bay portion of the SCA will be closed and rehabilitated.

* Vehicle access to the foreshore in the Myuna Bay portion of the SCA will be closed to the public and parking will be provided off Summerhill Drive.

* Public vehicle access to the southern section of the Morisset portion of the SCA will be closed.

* The Chain Valley Bay portion of the SCA will be fenced in strategic locations to prevent damage to rare and endangered plant species caused by unauthorised vehicle access.

* Interpretation and seating will be provided at lookouts at Awaba Bay and Wangi Point (Maps 1 and 2).

* Two day use areas with seating, interpretation and shelter will be provided at Awaba Bay (Map 1).

* Seating will be provided at Myuna Bay (Map 3).

* Safety railings on the jetty and around the old power station inlet at Myuna Bay will be upgraded in consultation with Pacific Power.

* Facilities at Woods Point will be reviewed. In the interim it will be maintained as a day use area, accessible on foot from Silky Oak Drive, or by water (Map 4).

* Expressions of interest will be invited for provision of camping facilities at Woods Point.

* An environmental assessment of existing toilets in Lake Macquarie SCA will be undertaken.

* A walking track, linking Bolton and Marmong Points, will be constructed at Awaba Bay (Map 1).

* Track route signs will be upgraded on all walking tracks at Wangi Point.

* Concepts for the development of a flora walk at Chain Valley Bay will be investigated in consultation with the local community.

* Signs indicating that domestic pets are not permitted within the reserve will be installed at all visitor access points.

* Wheelchair/stroller access will be provided to the foreshore at Wangi Point.

* Signs and park information will encourage visitors to remove their own rubbish.

4.3.2.2 Pulbah Island NR

As a nature reserve and significant Aboriginal Place, Pulbah Island has been managed by the NPWS to encourage minimal impact recreation such as bushwalking, picnicking and fishing. People also visit the island for snorkelling, to see its flora and fauna and as a safe boat mooring (Olejnik, 1999). Locals and visitors have stated that they enjoy its quiet beauty and unspoiled character.

More intensive uses than these are not consistent with conservation of the key values of the island, as it contains a variety of habitats that are sensitive to disturbance from excessive use. Alternative recreational opportunities are provided in nearby Lake Macquarie SCA. Periodically requests are made for more facilities on the island. These would lead to increased visitation and illegal camping.

Because of the requirement for boat access to service the island and enforce regulations the management of illegal uses is a challenge.

Most litter and human waste problems on the island appear to be the result of illegal camping. Enforcement of regulations by the NPWS will reduce the incidence of illegal activities, thus reducing problems associated with litter and human waste. These issues will further be addressed through a public education program and regular patrols and clean ups by the NPWS. Toilet facilities are provided at nearby Wangi Point and will not be provided on the island.

Camping and domestic pets are not permitted on the island.

It is planned that existing walking tracks be maintained to prevent further erosion, minimise encroachment into sensitive area and provide a safer bushwalking experience for visitors. It is not intended to maintain walking tracks to a high standard.

Policies

* Public use of Pulbah Island NR will be limited to low impact day use which promotes appreciation and enjoyment of the reserve and is consistent with the objectives of this plan of management.

* Other than maintenance of walking tracks to prevent erosion, visitor facilities will not be provided on Pulbah Island.

* Bush walking will be permitted in the reserve and minimum impact bushwalking codes will be promoted.

* Camping will not be permitted in the nature reserve.

* Any organised activities within the nature reserves will require permission of the NPWS Central Coast Hunter Range Regional Manager. Conditions of use may include:

    - limits on group sizes and frequency of use to minimise environmental impacts.

    - activities must have an educational focus.

    - program leaders will be required to have appropriate qualifications and experience.

* Domestic pets will not be permitted in the reserve.

* Signs and information in brochures will encourage visitors to remove their rubbish from the island.

Actions

* Signs will be installed and maintained to explain appropriate uses.

* A public education program to promote the environmental values of the island and appropriate use will be developed and implemented.

* Signs encouraging visitors to take their rubbish with them will be installed.

* Regular patrols of the island will be conducted by the NPWS to remove rubbish, maintain signs and walking tracks (where required) and to ensure that visitors adhere to regulations.

* The introduction of dung beetles to assist with the management of human waste will be investigated. If this appears to be potentially beneficial, an environmental impact assessment will be undertaken prior to their release.

* The impacts of bush walking on the island will be monitored and this activity may be temporarily or permanently excluded from all or part of the reserve if necessary.

4.3.2.3 Moon Island NR

As a nature reserve, access and recreation are not encouraged on Moon Island. No facilities will be provided on the island as intensive use is inconsistent with the conservation of important seabird roosting and nesting sites found on the island.

Policies

* Recreational use of Moon Island will not be encouraged.

Actions

* Signs will be installed identifying Moon Island as a nature reserve.

4.3.3 Scientific Research

Scientific research can provide information which may assist the Service to improve management of the natural and cultural heritage of its reserves and to understand the processes that affect them. Research is also used by the Service to establish requirements for the management of particular species and visitor requirements. In the Lake Macquarie area, research into the viability of including other remnant bushland areas in the NPWS reserve system would be worthwhile.

Students from the University of Newcastle and other organisations have assisted in understanding the values of these reserves.
All scientific research in the reserves is required to be authorised in accordance with the *National Parks and Wildlife Act 1974* under the general licence issued by the Service.

A complete fauna survey of the reserves has not yet been undertaken and is one priority for future research. The extent of weed infestation has been documented, however additional survey work is required, particularly to identify occurrences of noxious weeds. Research into the impacts of fire on native species will be encouraged to more fully understand the possible future impacts on the reserves.

Several sections of the SCA are poorly known in terms of their recent land use history and the survival of associated physical evidence. Research in this area will be facilitated. Planning for visitor facilities in the SCA also requires a better understanding of the number of visitors.

Policies

* Research will be encouraged into all aspects of the reserves. Projects that will assist reserve management will be given highest priority.

* Research applications will be approved where:

  – research has the potential to facilitate improved management of the reserves; and/or

  – the research conforms with the objectives of this plan of management.

* The Service will develop a research prospectus which will identify annual priorities and funding arrangements for research projects.

Actions

* Priority for research will be given to:

  – Fauna surveys of the Wangi Point, Morisset and Awaba Bay sections of the SCA and Pulbah Island NR (2003 and 2004);

  – completion of a weed species survey in the Chain Valley Bay, Myuna Bay and Morisset sections of the SCA;

  – the identification and management of threatened native plant and animal communities;

  – the effect of fire on native plant and animal communities, in particular those containing threatened species such as *Tetratheca juncea, Genoplesium insignis, Syzigium paniculatum, Acacia bynoeana* and *Angophora inopina*;

  – a visitor survey to assist in the preparation of an SCA visitor profile and plan for visitor facilities (2002); and

  – landuse history of the Chain Valley Bay and Point Wolstoncroft sections of the SCA.

4.3.4 Management Operations

This section of the plan addresses the management operations of NPWS and uses of the reserves by other agencies, organisations and individuals. The reserves are located in the NPWS Central Coast Hunter Range Region and are managed from the Lakes Area office and works depot off Elizabeth Bay Drive, Lake Munmorah.

There are fourteen easements in, or adjacent, to Lake Macquarie SCA – five at Wangi Point, five at Morisset and four at Chain Valley Bay. The easements provide access to maintain utilities in the adjoining suburbs. A review of the easements that were in existence when the park was gazetted is required to clarify rights and responsibilities (eg for access and maintenance).

There are two permissive occupancies in the SCA, both at Awaba Bay. Structures associated with Alexander's occupancy have been removed and rights of occupancy are understood to have been terminated with their removal. Hepplewhite's occupancy and use of this section of the reserve is not covered by

any formal agreement with the NPWS. A formal agreement for the occupancy of this land will be made with Mr Robert Hepplewhite.

There are several other pre-existing uses that need to be formalised through leasing or management agreements. These include the community radio station at Morisset, foreshore areas east of Morisset Hospital, the Point Wolstoncroft Sport and Recreation facility and the Chain Valley Bay Van Village. The Wangi Point Tourist Park has a valid lease.

The management trail system is shown on Maps 1 to 6. Lake Macquarie City Council and Wyong Shire Council manage parts of the trail system as public roads or as lessees (eg Wangi Point Tourist Park internal roads).

The state conservation area is reserved to a depth of 20 metres in recognition of the significant coal reserves and coal extraction activities that exist in the Lake Macquarie catchment. The area is underlain by coal from a number of seams which form part of the underground resource base for several operating collieries. Section 47J of the National Parks and Wildlife Act states that the *Mining Act 1992*, the *Offshore Minerals Act 1999*, the *Petroleum (Onshore) Act 1991* and the *Petroleum (Submerged Lands) Act 1982* apply to lands within a state conservation area and that the Minister may give concurrence to mining interests and renewals of mining interests within the area. Mineral claims, however, may not be granted. Mining and related activities are not permitted in nature reserves. The potential impacts of mining activities, and particularly of mine subsidence, remains a major issue of concern for the Service within Lake Macquarie State Conservation Area and Pulbah and Moon Island Nature Reserves.

Community involvement in management programs in the reserves include:

- Wangi Peninsula Landcare Group at Wangi Point.
- Awaba Bay Landcare Group at Awaba Bay.
- Pulbah Island clean ups and weed removal.
- A Community Service Order program run by NSW Probation and Parole Service of the NSW Department of Corrective Services assists with ground maintenance.

There are no easements or access rights over Pulbah Island.

A navigational beacon is located on the northern side of Moon Island NR. An easement for this beacon will be formalised.

Policies

* The management trails shown on maps 1 to 6 will be maintained for use by the NPWS or other agencies for authorised management purposes.

* All management trails and structures will be maintained according to NPWS guidelines (NPWS Guidelines For Park Facilities 1995).

* Access to management trails by private vehicles will not be permitted without authorisation from the NPWS.

* No additional management trails will be constructed in the reserves.

* Mining and related proposals or renewals of mining interests within the state conservation area will be considered in accordance with legislative requirements, government policy and joint NPWS and Mineral Resources exploration and mining activity protocols.

* Pre-existing rights and uses of the SCA will be reviewed to determine if they are appropriate and to ensure formal agreements are in place.

* Community programs will continue to be supported and opportunities to expand them to other areas will be pursued.

Actions

* Easements will be reviewed to ensure legal access is provided and maintenance and management responsibilities are clear.

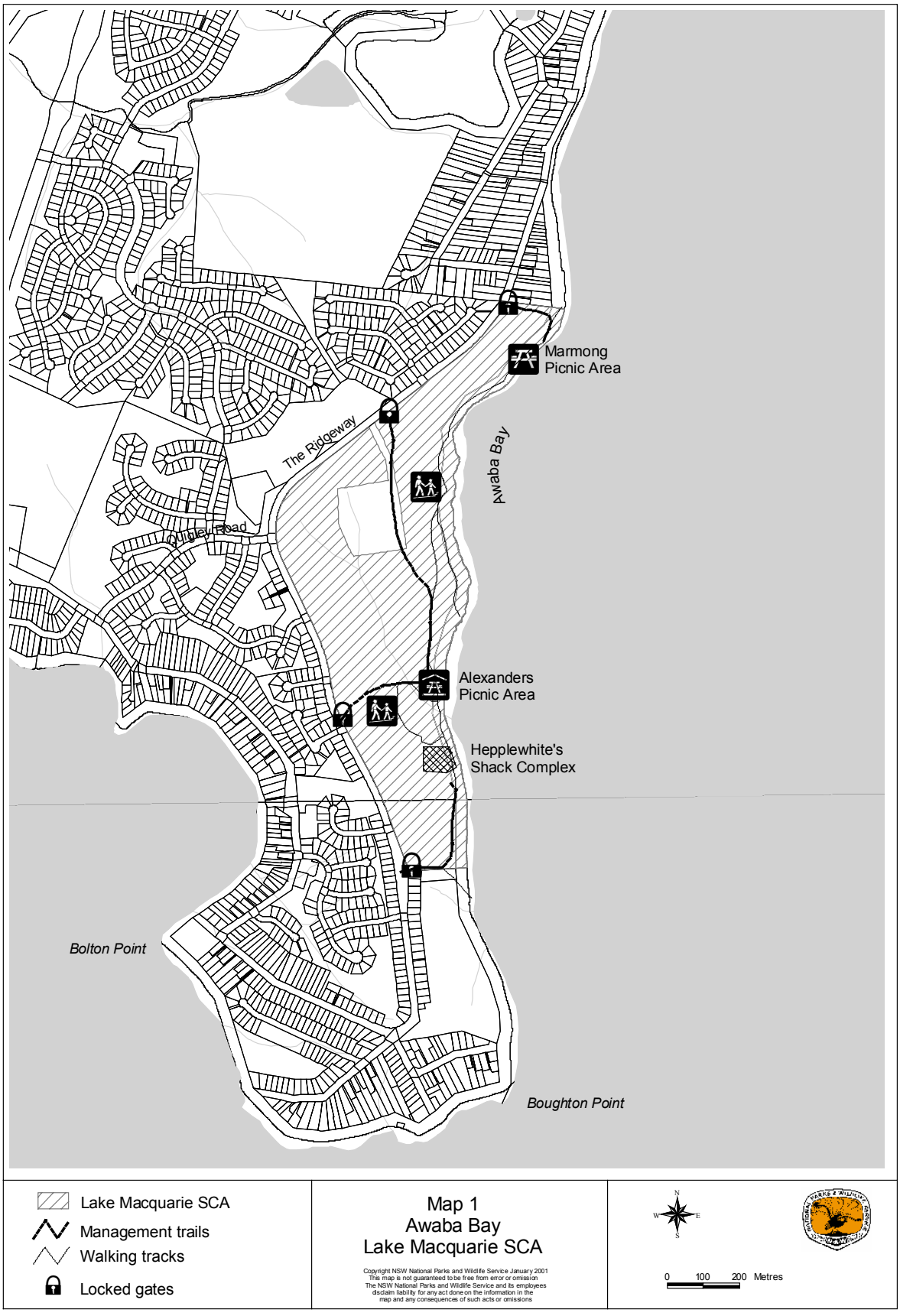
* Leases or management agreements will be formalised for the Morisset Radio Station, Morisset Hospital eastern foreshore, the Department of Sport and Recreation facility at Point Wolstoncroft, the Chain Valley Bay Van Village and Hepplewhite's occupancy at Awaba Bay.

* Management trails throughout Lake Macquarie SCA will be maintained to a standard suitable for fire management purposes (Maps 1 to 6).

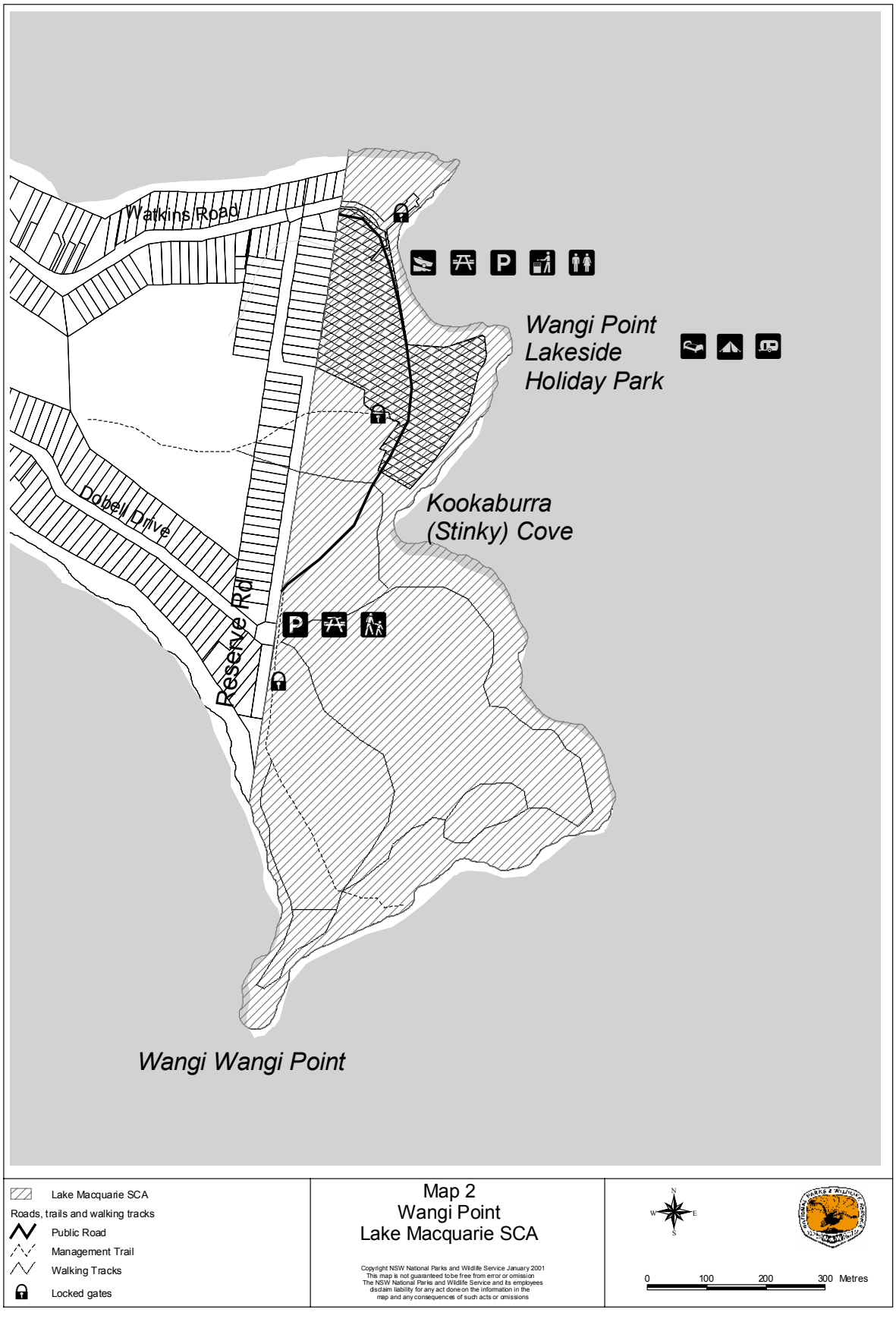
* The trail from the Point Wolstoncroft Sport and Recreation Centre north to the point will remain closed to public vehicular access and will be maintained for fire management.

* NPWS will work with the Department of Mineral Resources and mining companies to minimise the impacts of mining activities and mining subsidence on the reserves.

MAP 1
Awaba Bay, Lake Macquarie SCA.

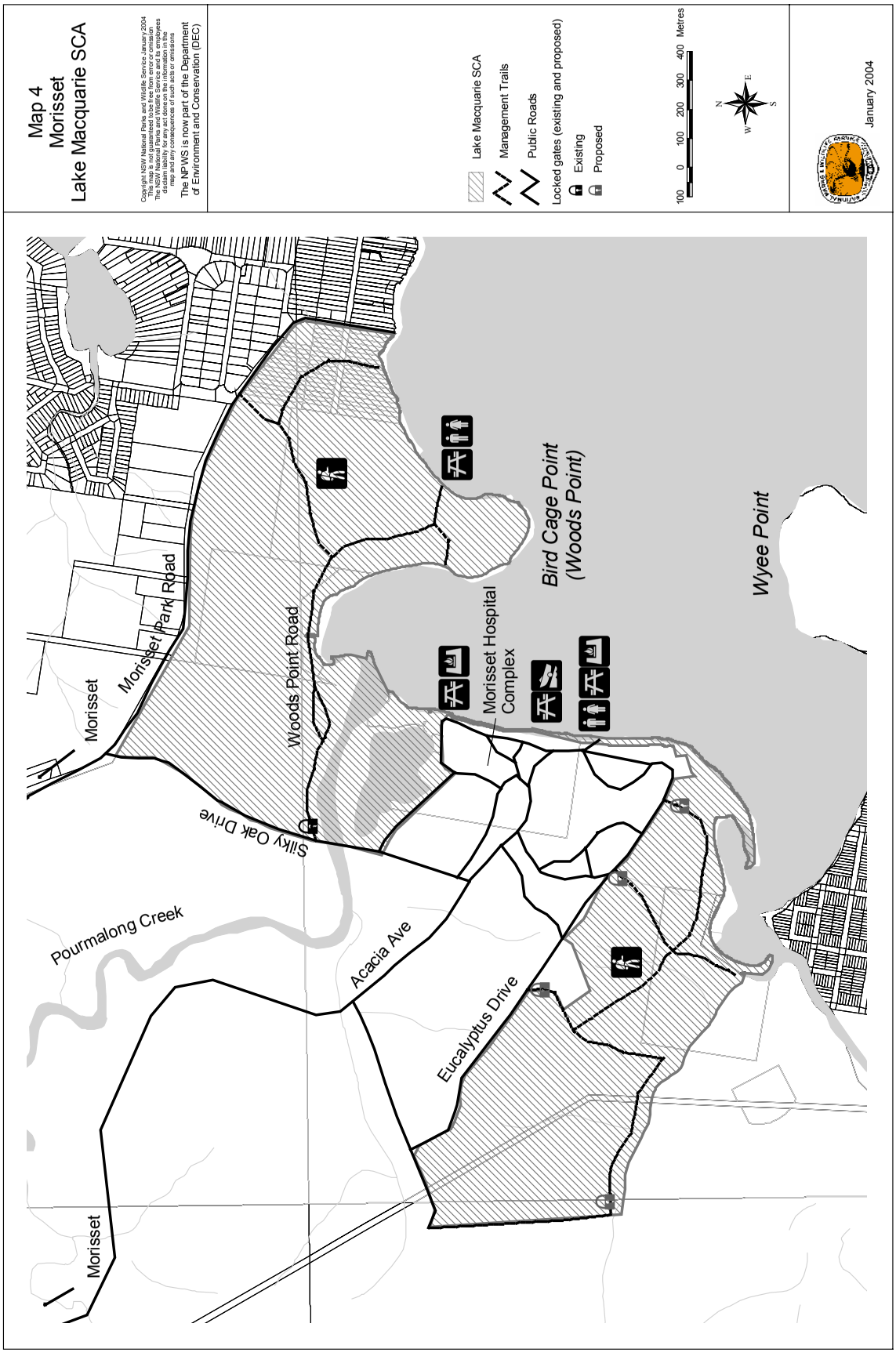


MAP 2
Wangi Point, Lake Macquarie SCA.

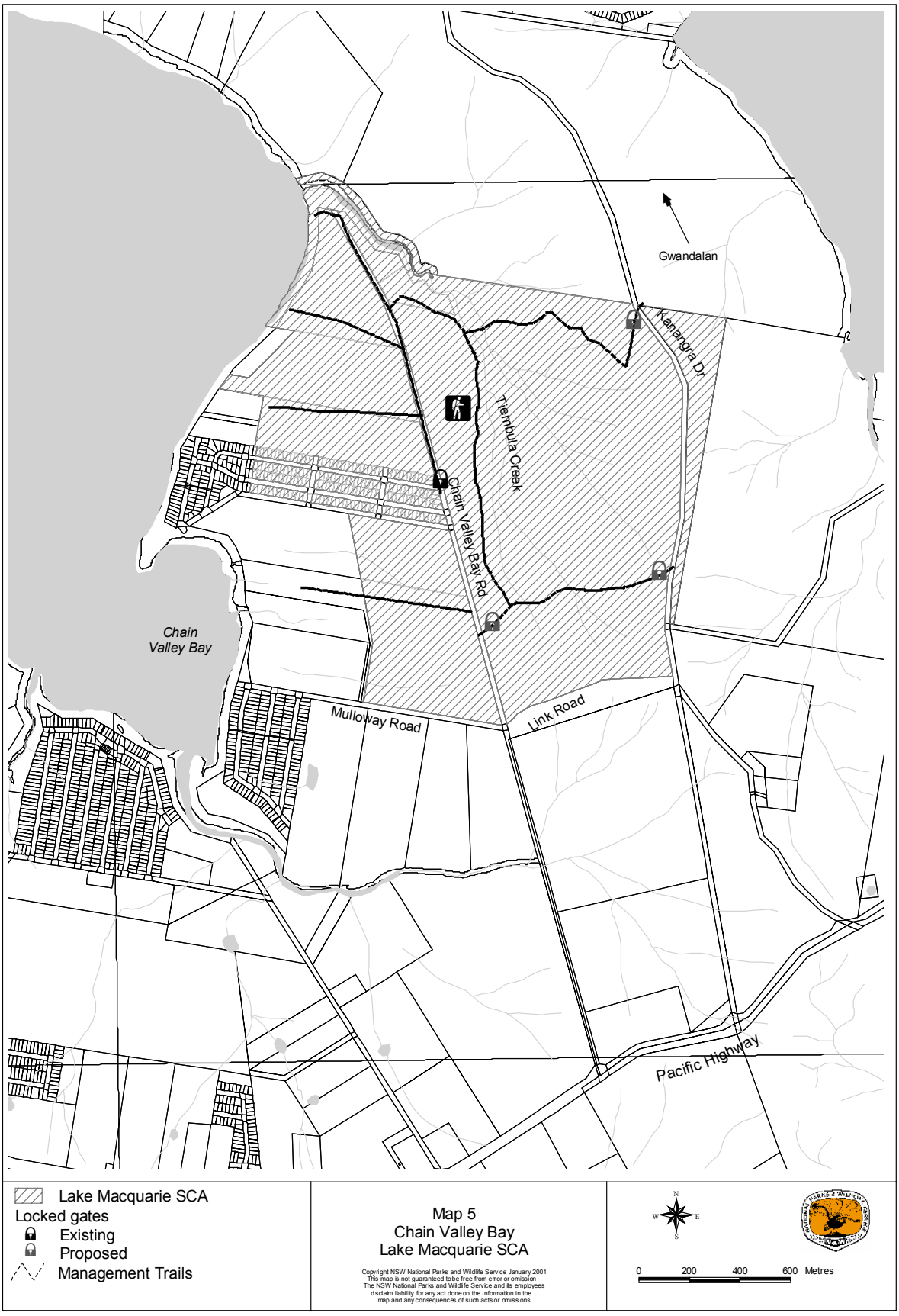


MAP 3
Myuna Bay, Lake Macquarie SCA.

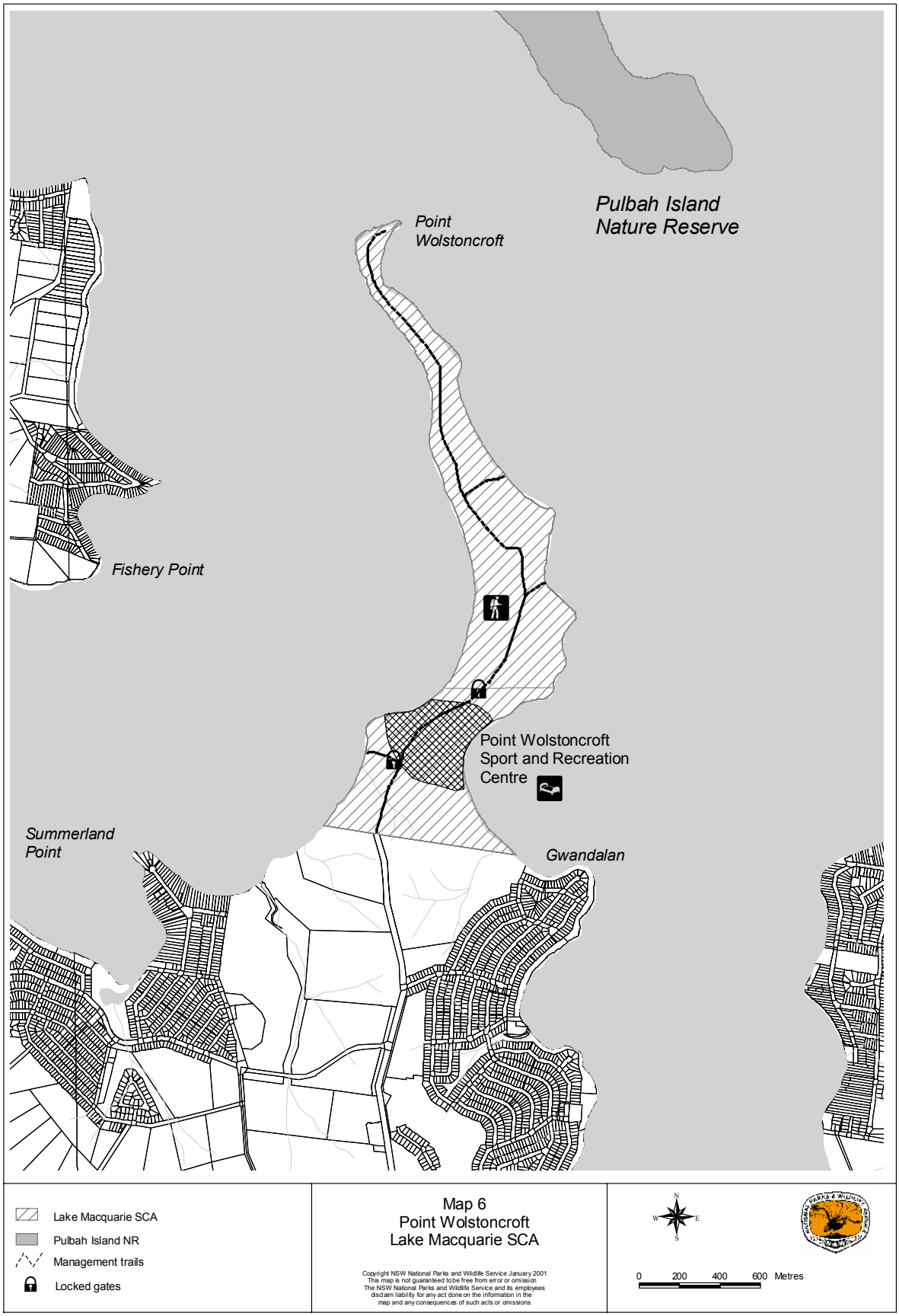
Map 4
Morisset, Lake Macquarie SCA



MAP 5
Chain Valley Bay, Lake Macquarie SCA



MAP 6
Point Wolstoncroft, Lake Macquarie SCA.



5. PLAN IMPLEMENTATION

This plan will be implemented via the annual programs of the NPWS Central Coast Hunter Range Region. Priorities will be influenced by regional priorities, availability of resources and specific requirements of the Director-General or the Minister.

As a guide to the implementation of the plan of management respective priorities for actions are outlined below.

Activities	**Page**
High Priority	
Participation and support to the Central Coast Catchment Management Board and the Catchment Blueprint	4.1.1
Reduce erosion and sedimentation – Lake Macquarie SCA	4.1.1
Review trails – Chain Valley Bay, Morisset, Myuna Bay	4.1.1
Continue to support volunteer bush regeneration programs	4.1.2
Increase community involvement in volunteer bush regeneration programs	4.1.2
Control noxious weeds	4.1.2
Prepare annual weed control programs	4.1.2
Increased promotion of volunteer bush regeneration activities	4.1.2
Undertake neighbour relations program re pets	4.1.3
Implement vertebrate pest control program	4.1.3
Maintain management trails	4.1.4
Undertake hazard reduction activities	4.1.4
Participation in the Lake Macquarie and Wyong Bush Fire Management Committees	4.1.4
Monitor & protect Aboriginal sites – Pulbah Island	4.2.1
Maintain liaison with Aboriginal people and groups	4.2.1
Restrict vehicle access – Myuna Bay	4.3.2
Review access – Morisset	4.3.2
Fence and gate - Chain Valley Bay	4.3.2
Assessment of toilets – Lake Macquarie SCA	4.3.2
Review facilities – Woods Point, Awaba Bay and Point Wolstoncroft	4.3.2
Improved visitor facilities – Myuna Bay, Awaba Bay	4.3.2
Improved walking track system	4.3.2
Formalise lease arrangements at Morisset	4.3.4
Review easements – Lake Macquarie SCA	4.3.4
Medium Priority	
Complete weed survey – Morisset, Chain Valley Bay, Myuna Bay	4.1.2
Prepare weed management strategies – Morisset and Pulbah Island	4.1.2
Implement weed management program for environmental weeds	4.1.2
Undertake rare and threatened plant surveys	4.1.2
Undertake fauna surveys	4.1.3
Undertake vertebrate pest surveys	4.1.3
Prepare vertebrate pest control plans	4.1.3
Complete detailed fire history records	4.1.4
Complete fire plan	4.1.4
Complete Aboriginal heritage survey – Pulbah	4.2.1
Complete historic heritage recording – Awaba Bay, Myuna Bay, Pulbah Island	4.2.2
Increase promotion and educational use	4.3.1
Prepare printed interpretive information – Pulbah brochure & others	4.3.1
Increase and upgrade interpretive material	4.3.1
Develop parking strategies – Awaba Bay, Myuna Bay, Chain Valley Bay	4.3.2

Seal road through Wangi Point Tourist Park	4.3.2
Seal and landscape Wangi Point boat ramp	4.3.2
Provide car park & signs – Myuna Bay	4.3.2
Conduct visitor survey	4.3.2
Provide car park & signs – Chain Valley Bay	4.3.2
Investigate options for boat sewage pumpout facility at Wangi Point	4.3.2
Formalise all required leases – Lake Macquarie SCA	4.3.4

Low Priority

Preparation of species profiles for the reserves	4.1.3
Research fuel characteristics and fire hazards in the reserves	4.1.4
Promote fire awareness education	4.1.4
Promote historical research	4.2.2
Increased Discovery activities	4.3.1
Prepare research prospectus	4.3.3

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APPENDIX 1
VEGETATION COMMUNITIES IN THE SCA AND NR'S

The following description of the vegetation communities is based on survey work undertaken in 1998 and 2000 by Stephen Bell. The two highly modified communities he identified are not included.

Macquarie Relic Dry Rainforest
Dominant trees: *Backhousia myrtifolia* (Grey Myrtle). *Angophora costata* (Smooth Barked Apple), and *Eucalyptus umbra* (Bastard Mahogany). Shrubs include *Backhousia myrtifolia*, *Notolea lingofolia var intermedia* (Mock Olive), and *Acacia longifolia* (Sydney Golden Wattle). This community generally occurs in small stands in the Lake Macquarie area on shallow sandy soils and has been recorded in a gully at Wangi Point.

This community is poorly conserved at the local level and poorly to moderately conserved at the regional and national level. Threats to the stand at Wangi Point include pedestrian traffic and too frequent fire – fire sensitive species may have been eliminated.

Narrabeen Macquarie Ironbark Forest
Dominant trees: *Eucalyptus siderophloia* (Northern Grey Ironbark), *Eucalyptus paniculata ssp. Paniculata* (Grey Ironbark). *Eucalyptus crebra* (Narrow Leaved Ironbark), *Eucalyptus oblonga* (Stringybark) and *Allocasuarina torulosa* (Forest Oak). Shrubs include *Jacksonia scoparia* (Dogwood), *Notolaea longifolia var. intermedia*, *Rapanea variabilis* (Muttonwood), *Acacia falcata* (Sickle Wattle), *Dodonaea triquetra* (Common Hopbush), *Daviesia ulicifolia* (Gorse Bitter Pea), *Leucopogon juniperinus* (Beard Heath), *Acrotriche divaricata* (Ground Berry) and *Cassinia aculeata* (Dolly Beard).

This community is found on shallow sandy clay soils on Munmorah conglomerates in the Point Wolstoncroft section of the reserve. Threats include invasion by Bitou Bush. Considered poorly conserved locally and very poorly conserved at the regional and national level.

Narrabeen Crangan Bay Coastal Forest
Dominant trees: *Angophora costata, Eucalyptus racemosa* (Narrow Leaved Scribbly Bark), *Corymbia gummifera* (Red Bloodwood). Shrubs: *Daviesia ulicifolia, Pultenaea palacea* (Pea), *Pimelia linifolia ssp. Linifolia* (Slender Rice Flower), *Acacia myrtifolia* (Myrtle Wattle), *Acacia falcata, Oxylobium ilicifolium* (Native Holly), *Epacris pulchella* (NSW Coral Heath), *Acacia ulicifolia* (Prickly Moses), *Jacksonia scoparia*, Allo*casuarina littoralis* (Black She Oak), *Monotoca scoparia* (Prickly Broom Heath) and *Xanthorrhoea latifolia ssp. Latifolia* (Grass Tree). Grasses – *Themeda australis, Entolasis stricta* and *Chionochloa pallida* are prominent.

The presence of species more typical of the Permian Macquarie grassy forest, such as *Jacksonia scoparia* and *Daviesia ulicifolia* distinguish this community from the Narrabeen Doyalson coastal forest. This community may provide habitat for *Tetratheca juncea*.

The community is found on yellow-brown sandy soils, on ridges and slopes in a small section of the reserve at the southern end of Point Wolstoncroft. Considered to be poorly conserved.

Narrabeen Doyalson Coastal Forest
Eucalyptus racemosa, Angophora costata, Corymbia gummifera, Eucalyptus haemastoma, Eucalyptus globoidea (White Stringy Bark), *Eucalyptus capitellata* (Brown Stringy Bark), *Allocasuarina littoralis*. Shrubs: *Acacia longifolia, Dodonaea triquetra, Dillwynia retorta* (Heathy Parrot Pea), *Gompholobium latifolium* (Broad Leaf Wedge Pea), *Monotoca scoparia, Xanthorrhoea latifolia ssp. Latifolia*, *Epacris pulchella, Leptospermum polygalifolium* (Lemon Scented Tea Tree), *Pultenaea palacea, Pimelia linifolia ssp. Linifolia*, *Polyscias sambucifolia ssp. A* (Elderberry Panax) and *Acacia terminalis* (Sunshine Wattle).

Acacia longifolia, Dodonaea triquetra Pteridium esculentum (Bracken*), Gonocarpus teucridoides* (Germander Raspwort) and *Phyllanthus hirtellus* (Spurge) are characteristic of the forest and distinguish it from the Narrabeen Doyalson coastal woodland. The community is likely to be habitat for the threatened species *Tetratheca juncea* and *Macrozamia flexuosa.* It is found on shallow grey sandy loams in sheltered locations on slopes and ridges at Morriset Hospital and Chain Valley Bay. The community is threatened by regular fire and is considered to be poorly conserved locally and moderately conserved at the regional level.

Sydney Sandstone Sheltered Dry Forest
Main trees: *Eucalyptus piperita* (Sydney Peppermint), *Angophora costata, Allocasuarina torulosa* (Forest Oak), *Elaeocarpus reticulatus* (Blueberry Ash). Main shrubs*: Rapanea variabilis, Glochidion ferdinandii var ferdinandii* (Cheese Tree*), Elaeocarpus reticulatus, Bursaria spinosa* (Blackthorn), *Polyscias sambucifolia, Dodonaea triquetra, Notolaea longifolia var. intermedia, Pittosporum revolutum* (Yellow Pittosporum) and *Clerodendrum tomentosum* (Hairy Clerodendrum). The Sydney sandstone sheltered dry forest is distinguished from other forest communities by the presence *of Eucalyptus piperita, Angophora costata and Allocasuarina torulosa* and the large variety of herbs in the understory.

This community is found only in small pockets at Point Wolstoncroft and Myuna Bay – it has been invaded by *Lantana camara* and there is potential for other weed invasion downstream of urban areas. It is considered to be adequately conserved at the local and wider level.

Permian Macquarie Grassy Forest
Dominant tree species include: *Corymbia maculata* (Spotted Gum), *Eucalyptus punctata* (Grey Gum), *Corymbia gummifera* (Red Bloodwood), *Angophora costata, Eucalyptus paniculata ssp paniculata* (Grey Ironbark), *Eucalyptus siderophloia* (Northern Grey Ironbark) and *Eucalyptus umbra*. The main shrubs are *Pultenaea euchila* (a Pea*), Daviesia ulicifolia, Oxylobium licifolium, Acrotriche divarcata* (Ground Berry*), Persoonia linearis* (Narrow Leaved Geebung), *Pultenaea villosa, Acacia implexa* (Hickory), *Acacia longifolia, Dodonaea triquetra, Exocarpus cupressiformis* (Cherry Ballart) and *Acacia falcata*. This community is distinguished by the dominance of ironbarks and the absence of *Corymbia maculata* and *Eucalyptus punctata*. Threatened and rare species include *Tetratheca juncea* and *Macrozamia flexuosa*.

This type is widely distributed in the northern sections of the SCA where it occurs on shallow clayey soils mainly on the Newcastle coal measures. Most areas are disturbed by fire trails used for rubbish dumping. Considered poorly conserved locally and very poorly conserved regionally and nationally.

Permian Macquarie Paperbark Gully Forest
Dominant trees are: *Melaleuca stypheliodes* (Prickly Leaved Tea Tree), *Eucalyptus piperita* and *Angophora costata*. Main shrubs are *Pittosporum undulatum* (Sweet Pittosporum), *Logania albiiflora*, *Clerodendrum tomentosum* and *Breynia*

oblongifolia (Breynia). Distinguished from other dry forest by the presence of *Melaleuca stypheloides* and other wet sclerophyll shrubs.

This type of forest has been recorded at Myuna Bay where it is infested with Lantana, *Ligustrum sinese* (Small Leaved Privet) and *Ageratina adenophora* (Crofton Weed). Found on clay loam or alluvial soils often where drainage is poor. Is locally, regionally and nationally poorly conserved.

Coastal Sandplain Scribbly Gum Forest
Main trees are *Eucalyptus signata* (Northern Scribbly Gum), *Corymbia gummifera* and *Angophora costata*. The main shrubs are *Leptospermum trinervium* (Paperbark Tea Tree), *Acacia terminalis, Allocasuarina littoralis, Banksia serrata* (Old Man Banksia*), Dillwynia retorta, Ricinocarpus pinifolius, Leptospermum polygalifiolium ssp. Cismontamum* (Lemon Scented Tea Tree), *Platysace linearifolia* (Carrot Tops), *Epacris pulchella, Boissaea heterophylla, Hovea longifolia, Boissaea ensata, Acacia ulicifoila, Acacia suaveolens, Monotoca scoparia, Pimelia linifolia ssp. Linifolia, Gompholobium latiffolium and Hibbertia aspera* (Rough Guinea Flower). Distinguished from other forests by the presence of species such as *Ricinocarpus pinifolius*, *Boissaea heterophylla, Boissaea ensata, Hovea longifolia* and *E. Signata* and the density of the understorey.

The community is found at Morriset Hospital on grey – white sandy clays. It is considered to be very poorly conserved at the local, regional and national level. The section at Morisset is basically surrounded by wetter swampy vegetation and is in good condition – too frequent fire is seen as the only potential threat at that location.

Estuarine Swamp Oak forest
Casuarina glauca and *Eucalyptus tereticornis* are the dominant tree species. The understory consists of herbs, sedges (*Juncus kraussii ssp. Australiensis, Baumea juncea, Ghania clarkeii*) and grasses. The presence of *Casuarina glauca* and sedge dominated understorey distinguishes this community.

It is found at Morisset and is relatively common in small areas elsewhere in Lake Macquarie. This community occurs on silty, poorly drained saline influenced soils, generally behind Estuarine Mangrove open scrub and is considered to be adequately conserved locally and nationally.

Estuarine Melaleuca Swamp Forest
The dominant tree is *Melaleuca quinquenervia*, occasionally with *Casuarina glauca* and *Eucalyptus robusta*. The main shrubs are *Acacia longifolia, Melaleuca quinquenervia, Glochidian ferdinandi var. ferdinandi* and *Goodenia ovata*. Structural differences and the presence of *Goodenia ovata* and *Casuarina glauca* distinguish this community from other estuarine communities. It is found at Chain Valley Bay on dark brown silty clays with occasional tidal influences and is considered poorly conserved at the local and regional level.

Coastal Alluvial Mahogany Swamp Forest
Eucalyptus robusta, Eucalyptus tereticornis and *Angophora costata* are the main trees. Shrubs present include *Glochidion ferdinandi var ferdinandi, Leptospermum juniperinum* and *Pultenaea villosa*. The presence of vines (*Kennedia rubicunda, Smilax glyciphylla* and *Hibbertia scandens*) and *Glochidion* distinguish the community.

It is found on clay – loam soils on alluvial flats and in the reserve occurs only at Morisset. The community is thought to be moderately well conserved locally and more widely, with potential threats from altered fire regimes.

Coastal Alluvial Depression Swamp Forest
Main trees present include *Eucalyptus robusta, Melaleuca sieberi, Eucalyptus resinifera* and *Angophora costata*. Shrubs include *Leptospermum juniperinum, Acacia longifolia, Pultenaea villosa, Callistemon citrinus, Acacia elongata var. elongata, Banksia robur, Melaleuca thymifolia* and *Pultenaea retusa*. This community is considered marginal habitat for the vulnerable *Angophora inopina* and is distinguished by the presence of *Melaleuca sieberi*, *Melaleuca thymifolia*, the sedges *Tetraria capillaris* and *Lepyrodia scariosa*, and the grass *Entolasia stricta*.

The swamp forest occurs in shallow drainage lines on deep grey or brown loams with poor drainage and has been recorded at Chain Valley Bay and Morisset. The community is considered to be very poorly conserved locally and poorly conserved at the broader level. High frequency fire is considered as the main threat.

Coastal Alluvial Flat Swamp Forest
The main trees are *Angophora costata*, *Eucalyptus robusta*, *Eucalyptus tereticornis*, *Angophora floribunda and Allocasuarina littoralis*. The main shrubs are *Acacia longifolia*, *Acacia myrtifolia*, *Dodonaea triquetra*, *Glochidion ferdinandi var ferdinandi*, *Leptospermum ploygalifolium ssp. Ploygalifolium*, *Ployscias sambucifolia ssp. A*, *Breynia oblongifolia*, *Pultenaea villosa* and *Acacia terminalis*.

It is distinguished from other coastal alluvial forest types by having a well developed small tree and shrub layer and dense areas of *Acacia longifolia* and other shrubs.

The community is found at Morisset and Chain Valley Bay on deep alluvial silty clay loams. It is considered poorly conserved with the main threats being alterations to drainage regimes and weed invasion.

Freshwater Melaleuca Swamp Forest
Melaleuca linariifolia is the main tree sometimes associated with *M. Stypheloides*. Shrubs include *Ficus macrophylla car. Macrophylla* and *Glochidion ferdinandi var ferdinandi*. The dominance of *Melaleuca linariifolia* is the distinctive feature of this community, with the sedge *Carex appressa* and fern *Blenchum indicum* in the understorey. It is found only in a small area at Awaba Bay on dark brown peaty loams in a poorly drained depression. Very poorly conserved locally and more widely. The threats at Awaba Bay are weed spread from adjoining modified land – Lantana is already present.

Narrabeen Doyalson Coastal Woodland
Eucalyptus haemastoma, *Corymbia gummifera* and *Eucalyptus capitellata* are the main trees. Shrubs include *Leptospermum trinervium*, *Acacia suaveolens*, *Banksia oblongifolia*, *Hakea dactyloides*, *Hakea bakeriana*, *Pultenaea sp. H*, *Leucopogon esquamatus*, *Lambertia formosa*, *Pimelia linifolia ssp. Linifolia*, *Grevillia sericea*, *Petrophile pulchella*, *Isopogon anemonifolius*, *Bossiaea stephensonii*, *Xanthorrhoea latifolia ssp. Latifolia*, *Kunzea capitata*, *Hakea teretifolia* and *Platysace linearifolia*.

Rare and endangered species include *Acacia bynoeana*, *Angophora inopina*, *Tetratheca juncea* and possibly *Cryptostylus hunteriana* (a Tongue Orchid). The presence of *Eucalyptus haemastoma* and the shrubs *Petrophile pulchella*, *Isopogon anemonifoliuso*, *Grevillia sericea*, *Hakea dactyloides*, *Banksia oblongifolia* and the herb *Actinotus minor* are characteristic of this woodland.

The woodland occurs on shallow to skeletal soils on plateau landforms at Morisset and Chain Valley Bay. Is considered to be moderately represented in conservation reserves, threatened elsewhere by land clearing.

Narrabeen Macquarie Headland Thicket
The trees present are *Casuarina glauca* and *Eucalyptus umbra*, with occasional *Angophora costata*. Shrubs include *Rapanea variabilis*, *Cupaniopsis anacardioides*, *Breynia oblongifolia*, *Acacia longifolia, Clerodendrum tomenetosum* and *Westringia fruticosa*. Characterised by the dominance of *Casuarina glauca* and the absence of species like *Baumea juncea* and *Juncus kraussii ssp. Australiensis* in the ground layer.

In the reserve it is found on rocky headlands, on Narrabeen sandstone soils, at Wangi Point where is has been invaded by Lantana and other weeds. Is very poorly conserved locally and widely.

Macquarie Melaleuca Scrub – Forest
Melaleuca nodosa is the main tree, with occasional examples of *Casuarina glauca*. Shrubs include *Pittosporum undulatum*, *Dodonaea triquetra*, *Pultenaea villosa* and *Breynia oblongifolia*. The community generally consists of thick, low growing *Melaleuca nodosa* with little understorey. *Melaleuca nodosa* is uncommon or absent from the other communities. It is found at Morisset on deeper alluvial soils around Duckhole Lagoon and at Point Wolstoncroft in shallow depressions on Narrabeen sandstone soils. The community has been invaded by Lantana and asparagus fern (*Protasparagus aethiopicus*) at Morisset and disturbed by tracks and trails. The community is very poorly conserved locally and widely.

Estuarine Mangrove Open Scrub
The mangrove *Avicennia marina ssp. Australiensis* dominates and the sedge *Juncus kraussii ssp. Australiensis* is present. Found at Morisset on silty estuarine mudflats and major creeks and rivers with a tidal influence. Adequately conserved locally and elsewhere.

Narrabeen Coastal Clay Heath
The main shrubs are *Hakea teretifolia*, *Banksia oblongifolia*, *Leptospermum ploygalifolium ssp. Cismontanum*, *Epacris pulchella*, *Platysace linearifolia*, *Grevillia speciosa*, *Pimelia linifolia ssp. Linifolia*, *Leptospermum trinervium* and *Allocasuarina littoralis*. Is potential *Angophora inopina* habitat. Characterised by the absence of *Hakea teretifolia* (predominant in the Alluvial coastal intermediate heath community) and species adapted to poorer drainage.

The heath is found at Morisset and Chain Valley Bay on shallow clayey soils, often in poorly drained locations. It is thought to be moderately well conserved locally and elsewhere.

Alluvial Coastal Intermediate Heath
The main shrubs are *Melaleuca sieberi*, *Leptospermum polygalifolium ssp*. *Polygalifolium*, *Leptospermum juniperinum*, *Hakea teretifolia*, *Callistemon citrinus*, *Melaleuca thymifolia* and *Banksia robur*.

Characterised by moisture adapted species, such as *Leptospermum juniperinum* and *Callistemon citrinus*. Occurs at Chain Valley Bay near Tiembula Creek on deeper alluvial soils in low relief areas. Is poorly conserved locally, regionally and nationally. This community is threatened by disturbances within the catchment.

Narrabeen Coastal Impeded Sedgeland
Melaleuca sieberi, *Melaleuca thymifolia* and *Xanthorrhoea minor ssp. Minor*. Distinguished mainly by the absence of the herb *Sarcocornia quinqueflora*, found in the saltmash communities. It occurs in a section of Chain valley Bay on impeded clay soils on Narrabeen sandstones. Threats again include disturbance to the catchment. Very poorly conserved at all levels.

Estuarine Rushland
Species present are the rush *Typha orientalis* and the grass *Phragmites australis* – and the dominance of *Typha orientalis* distinguishes the community. Occurs in deep silty mud in brackish or fresh water at Wangi Point and Awaba Bay. The community is considered to be adequately conserved.

Estuarine Saltmarsh
Consists of the herbs *Sarcocornia quinqueflora ssp. Quinqueflora*, *Einadia hastata*, *Salmolus repens* and *Suaeda australis* and the grasses *Zoysia macrantha* and *Sporobulus virginicus*. In the reserve is found around the Duckhole Lagoon at Morisset and is considered adequately conserved.

APPENDIX 2
ORCHID SPECIES RECORDED IN LAKE MACQUARIE SCA

Acianthus fornicatus
Acianthus pusillus
Arthrochilus prolixus
Caladenia alata
Caladenia carnea
Caladenia catenata
Caladenia fuscata
Calochilus paludosus
Cryptostylis subulata
Dipodium variegatum
Diuris alba
Diuris aurea
Genoplesium sp
Glossodia minor
Lyperanthus suaveolens
Microtus parviflora
Microtis sp (possibly angusii)
Orthocerus strictum
Prasophyllum elatum
Pterostylis nutans
Thelmitra carnea
Thelmitra ixioides
Thelmitra media
Thelmitra affin media
Thelmitra pauciflora

APPENDIX 3
TERRESTRIAL VERTEBRATES OF THE SCA AND NR'S

Amphibians

Common Name	Scientific Name	Status
Common Eastern Toadlet	*Crinia signifera*	
Wallum Froglet	*Crinia tinnula*	V
Bleating Tree Frog	*Litoria dentata*	
Brown Toadlet	*Pseudophryne bibronii*	
Brown Striped Frog	*Limnodynastes peronii*	
Eastern Dwarf Tree Frog	*Litoria fallax*	
Leaf Green Tree Frog	*Litoria phyllochroa*	
Peron's Tree Frog	*Litoria peronii*	
Red-backed Toadlet	*Pseudophryne coriacea*	
Spotted Grass Frog	*Limnodynastes tasmaniensis*	
Broad-palmed Frog	*Litoria latopalmata*	
Freycinet's Frog	*Litoria freycineti*	
Dusky Toadlet	*Uperolia fusca*	
Green-thighed Frog *	*Litoria brevipalmata* *	V

* = recorded within 5 km of the reserve in Atlas and likely to occur in the SCA and / or NRs

Reptiles

Note: the Lace Monitor occurs on Pulbah Island and it is likely that many of the other species are present there also.

Common Name	Scientific Name	Status
Jacky Lizard	*Amphibolurus muricatus*	
Striped Skink	*Ctenotus robustus*	
Tree Skink	*Egernia striolata*	
Eastern Water Skink	*Eulamprus quoyii*	
Three-toed Skink	*Saiphos equalis*	
Grass Skink	*Lampropholis delicata*	
Garden Skink	*Lampropholis guichenotis*	
Eastern Blue-tongued Lizard	*Tiliqua scincoides*	
Lace Monitor	*Varanus varius*	
Red-bellied Black Snake	*Pseudechis porphyriacus*	
Black-bellied Swamp Snake *	*Hemiaspis signata* *	
Krefft's Dwarf Snake	*Cacophis krefftii*	
Diamond Python	*Morelia spilota ssp. spilota*	

* = recorded within 5 km of the reserve in Atlas and likely to occur in the SCA and / or NRs

Mammals

Common Name	Scientific Name	Status
Common Bent-wing Bat	*Miniopterus schreibersii*	V
Eastern Broad-nosed Bat	*Scotorepens orion*	
Little Forest Bat	*Vespadelus vulturnus*	
Little Bent-wing Bat	*Miniopterus australis*	V
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	
Yellow-bellied Sheath Tailed Bat *	*Saccolaimus flaviventris* *	V

Chocolate Wattled Bat *	*Chalinolobus morio* *	
Gould's Wattled Bat	*Chalinolobus gouldii*	
Greater Broad-nosed Bat *	*Scoteanax rueppellii* *	V
Mastiff Bat *	*Mormopterus sp* *	
White-striped Mastiff Bat *	*Nyctophilus australis* *	
Grey-headed Flying Fox	*Pteropus poliocephalus*	V
Brown Antechinus	*Antechinus stuartii*	
Common Dunnart	*Sminthopsis murina*	
Bush Rat	*Rattus fuscipes*	
Water Rat	*Hydromys chrysogaster*	
Sugar Glider	*Petaurus breviceps*	
Squirrel Glider	*Petaurus norfolcensis*	V
Yellow-bellied Glider *	*Petaurus australis* *	V
Northern Brown Bandicoot	*Isoodon macrourus*	
Ring-tailed Possum	*Pseudocheirus peregrinus*	
Brush-tailed Possum	*Trichosurus vulpecula*	
Brush-tailed Phascogale *	*Phascogale tapoatafa* *	V
Eastern Grey Kangaroo	*Macropus giganteus*	
Swamp Wallaby	*Wallabia bicolor*	
Tiger Quoll *	*Dasyurus maculatus* *	V
Koala (Pulbah)	*Phascolarctos cinereus*	V

* = recorded within 5 km of the reserve in Atlas and likely to occur in the SCA and / or NRs

Native Birds

Note: Includes records from URGE and Awaba Bay Landcare Group and sightings from adjoining foreshores:

Common Name	**Scientific Name**	**Status**
Australasian Grebe	*Tachybaptus novaehollandiae* *	
Australasian Shoveler	*Anas rhynchotis* *	
Australian Kestrel	*Falco cenchroides*	
Australian King Parrot	*Alisterus scapularis*	
Australian Pelican	*Pelecanus conspicillatus*	
Australian Magpie	*Gymnorhina tibicen*	
Australian Raven	*Corvus coronoides*	
Bell Miner	*Manorina melanophrys*	
Black Bittern *	*Ixobrychus flavicollis* *	V
Black Cormorant	*Phalacrocorax carbo*	
Black Duck	*Anas superciliosa*	
Black Kite *	*Milvus migrans* *	
Black Swan	*Cygnus atratus*	
Black-faced Cuckoo Shrike	*Coracina novaehollandiae*	
Blue-faced Honeyeater *	*Entomyzon cyanotis* *	
Boobook Owl	*Ninox novaseelandiae*	
Brown Cuckoo Dove	*Macropygia amboinensis* *	
Brown Falcon *	*Falco berigora* *	
Brown Goshawk	*Accipiter fasciatus*	
Brown Honeyeater *	*Lichmera indistincta* *	
Brown Thornbill	*Acanthiza pusilla*	
Buff-banded Rail *	*Gallirallus philippensis* *	
Buff-rumped Thornbill	*Acanthiza reguloides*	
Caspian Tern *	*Sterna caspia* *	

Cattle Egret	*Ardeola ibis*	
Channel-billed Cuckoo	*Scythrops novaehollandiae*	
Chestnut Teal	*Anas castanea*	
Cicada Bird	*Coracina tenuirostris*	
Collared Sparrowhawk	*Accipiter cirrhocephalus*	
Comb-crested Jacana *	*Irediparra gallinacea* *	V
Common Sandpiper *	*Actitis hypoleucos* *	
Crested Pigeon	*Geophaps lophotes*	
Crested Tern	*Sterna bergii*	
Crimson Rosella	*Platycercus elegans*	
Darter	*Anhinga melaonogaster*	
Dollar Bird	*Eurystomus orientalis*	
Dominican Gull	*Larus dominicanus*	
Double-barred Finch	*Poephila bichenovii*	
Dusky Woodswallow	*Artamus cyanopterus*	
Eastern Rosella	*Platycercus eximius*	
Eastern Spinebill	*Acanthorhynchus tenuirostris*	
Eastern Whipbird	*Psophodes olivaceus*	
Eastern Yellow Robin	*Eopsaltria australis*	
Emerald Dove	*Chalcophaps indica*	
Fan-tailed Cuckoo	*Cuculus flabelliformis*	
Figbird	*Sphecotheres viridis*	
Fuscous Honeyeater *	*Lichenostomus fuscus* *	
Galah	*Cacatua roseicapilla*	
Glossy Black-cockatoo *	*Calyptorhynchus lathami* *	V
Glossy Ibis *	*Plegadis falcinellus* *	
Golden Whistler	*Pachycephala pectoralis*	
Golden-headed Cisticola *	*Cisticola exilis* *	
Great Egret	*Egretta alba*	
Great Knot	*Calidris tenuirostris*	V
Grey Butcherbird	*Cracticus torquatus*	
Grey Fantail	*Rhipidura fuliginosa*	
Grey Goshawk	*Accipiter novaehollandiae*	
Grey Shrike Thrush	*Colluricincla harmonica*	
Intermediate Egret	*Egretta intermedia*	
Jacky Winter	*Microeca leucophaea*	
Koel	*Eudynamis scolopacea*	
Laughing Kookaburra	*Dacelo novaeguineae*	
Leaden Flycatcher	*Myiagra rubecula*	
Lewin's Honeyeater	*Meliphaga lewinii*	
Little Black Cormorant	*Phalacrocorax sulcirostris*	
Little Egret	*Egretta garzetta*	
Little Friarbird	*Philemon citreogularis*	
Little Grassbird *	*Megalurus gramineus* *	
Little Lorikeet	*Glossopsitta pusilla*	
Little Penguin	*Eudyptula minor*	
Little Pied Cormorant	*Phalacrocorax melanoleucos*	
Little Wattlebird	*Anthochaera chrysoptera*	
Magpie Lark	*Grallina cyanoleuca*	
Mangrove Gerygone *	*Gerygone levigaster* *	
Masked Lapwing	*Vanellus miles*	
Masked Owl *	*Tyto novaehollandiae* *	V
Mistletoebird	*Dicaeum hirundinaceum*	

Musk Lorikeet	*Glossopsitta concinna*	
New Holland Honeyeater	*Phylidonyris novaehollandiae*	
Noisy Friarbird	*Philemon buceroides*	
Noisy Miner	*Manorina melanocephala*	
Olive-backed Oriole	*Oriolus sagittatus*	
Osprey *	*Pandion haliaetus **	V
Pacific Baza *	*Avicedea subcristata **	
Pallid Cuckoo	*Cuculus pallidus*	
Pied Butcherbird	*Cracticus nigrogularis*	
Pied Cormorant	*Phalacrocorax varius*	
Pied Currawang	*Strepera graculina*	
Pied Oystercatcher	*Haematopus longirostris*	V
Powerful Owl *	*Ninox strenua **	V
Purple Swamphen	*Porphyrio porphyrio*	
Rainbow Lorikeet	*Trichoglossus haematodus*	
Red Wattlebird	*Anthochaera carunculata*	
Red-browed Finch	*Neochmia temporalis*	
Reef Heron	*Egretta sacra*	
Royal Spoonbill	*Platalea regia*	
Rufous Whistler	*Pachycephala rufiventris*	
Sacred Kingfisher	*Halcyon sancta*	
Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*	
Scarlet Honeyeater	*Myzomela sanguinolenta*	
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*	
Silvereye	*Zosterops lateralis*	
Silver Gull	*Larus novaehollandiae*	
Spotted Pardalote	*Pardalotus punctatus*	
Sooty Owl *	*Tyto tenebricosa **	V
Sooty Oystercatcher	*Haematopus fuliginosus*	V
Spotted Quail Thrush	*Cinclosoma punctatum*	
Southern Emu-wren	*Stipiturus malachurus*	
Spangled Drongo	*Dicrurus megarhynchus*	
Spectacled Monarch *	*Monarcha trivirgatus **	
Straw-necked Ibis	*Threskiornis spinicollis*	
Striped Honeyeater *	*Plectorhyncha lanceolata **	
Sulphur-crested Cockatoo	*Cacatua galerita*	
Superb Fairy Wren	*Malurus cyaneus*	
Swift Parrot	*Lathamus discolor*	E
Tawny Frogmouth	*Podargus strigoides*	
Torresian Crow	*Corvus orru*	
Varied Sitella	*Daphoenositta chrysoptera*	
Variegated Fairy Wren	*Malurus assimilis*	
Wedge-tailed Shearwater	*Puffinus pacificus*	
Welcome Swallow	*Hirundo neoxena*	
Whistling Kite	*Haliastur sphenurus*	
White Ibis	*Threskiornis aethiopicus*	
White Breasted Sea Eagle	*Haliaeetus leucogaster*	
White-browed Scrubwren	*Sericornis frontalis*	
White-browed Woodswallow *	*Artamus superciliosus **	
White-cheeked Honeyeater	*Phylidonyris nigra*	
White-eared Honeyeater	*Lichenostomus leucotis*	
White-faced Heron	*Egretta novaehollandiae*	
White-fronted Tern	*Sterna striata*	

White-necked Heron	*Ardea pacifica*
White-throated Needletail	*Hirundapus caudacutus*
White-naped Honeyeater	*Melithreptus lunatus*
White-throated Gerygone	*Gerygone olivacea*
White-throated Needletail *	*Hirundapu caudacutus* *
White-throated Treecreeper	*Cormobates leucophaea*
White-winged Chough	*Corcorax melanorhamphos*
Willie Wagtail	*Rhipidura leucophrys*
Wood Duck	*Chenonetta jubata*
Yellow Thornbill	*Acanthiza nana*
Yellow-billed Spoonbill	*Plataea flavipes*
Yellow-faced Honeyeater *	*Lichenostomus chrysops* *
Yellow-tailed Black Cockatoo *	*Calyptorhynchus funereus* *
Yellow-faced Honeyeater	*Lichenostomus chrysops*

* = recorded within 5 kms of the reserve in Atlas and likely to occur in the SCA and / or NRs

LOCATION OF LAKE MACQUARIE SCA, PULBAH ISLAND NATURE RESERVE AND MOON ISLAND NR