Macquarie Island Nature Reserve and World Heritage Area

Management Plan 2006

AUSTRALIA

Tasmania

Macquarie Island Nature Reserve and World Heritage Area

Management Plan 2006

PARKS *and* WILDLIFE
SERVICE TASMANIA

DEPARTMENT *of*
TOURISM, ARTS
and the ENVIRONMENT

MACQUARIE ISLAND NATURE RESERVE AND WORLD HERITAGE AREA MANAGEMENT PLAN 2006

This management plan for the Macquarie Island Nature Reserve and World Heritage Area has been prepared in accordance with the requirements of Part 3 of the *National Parks and Reserves Management Act 2002*. This plan replaces the *Macquarie Island Nature Reserve Management Plan 1991* in accordance with s. 19(2)(b) of the *National Parks and Reserves Management Act 2002*. The appendices provide additional information and are not part of the statutory plan. In accordance with s.30(1)(a) of the *National Parks and Reserves Management Act 2002*, the managing authority for the reserve, in this case the Director of National Parks and Wildlife, will give effect to the provisions of this management plan.

This plan only applies to the Macquarie Island Nature Reserve and that part of the World Heritage Area that is within it, i.e. to 3 nautical miles. It does not apply to that part of the World Heritage Area between 3 and 12 nautical miles. It also does not apply to the Macquarie Island Marine Park on the eastern side of the reserve between 3 and 200 nautical miles.

Unless otherwise specified, this plan adopts the interpretation of terms given in s. 3 of the *National Parks and Reserves Management Act 2002*. The term 'Minister' when used in the plan means the Minister administering the *Act*. The term 'Director' refers to the Director of National Parks and Wildlife. The terms 'nature reserve' and 'reserve' refer to the Macquarie Island Nature Reserve. The term 'Macquarie Island' refers to the main island of the nature reserve and its waters to 3 nautical miles.

APPROVAL
This management plan was approved by His Excellency the Governor-in-Council on 29 May 2006 and took effect on 19 July 2006, being seven days after publication of that approval in the *Government Gazette*.

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Summary

Macquarie Island Nature Reserve is one of the most valuable reserves in Australia and the world, well recognised for its conservation, geological, ecological and scientific values. It is a World Heritage Area, a Biosphere Reserve, and is listed on the Register of the National Estate. The reserve is adjacent to the Australian Government Macquarie Island Marine Park, which is the second largest marine protected area in the world. The reserve is part of the State of Tasmania, managed by the Tasmanian Parks and Wildlife Service (PWS) of the Department of Tourism, Arts and the Environment.

Scientific research, management and long-term monitoring programs conducted over the last 50 years have contributed to knowledge and understanding of the reserve, to knowledge and understanding of global earth processes, and to global monitoring programs. These programs will be allowed to continue providing they cause no long-term adverse impacts on reserve values.

Due to recent changes in the Australian Government's Antarctic science program, the Australian Antarctic Division (AAD) will be reducing its support of research activities at Macquarie Island. The AAD may send only one vessel to the reserve each year for the foreseeable future. The impacts of such a reduction may affect research, management and monitoring programs in the reserve. Scientists, universities, other government agencies and educational tourism operators with a continuing interest in the reserve may need to develop alternative transport and logistic arrangements. Changes to management of the station and support facilities in the reserve may ultimately trigger a review of this management plan.

If the AAD were to decommission the station, removal of buildings and facilities and site clean-up would be the responsibility of the AAD as stated in Section 6.12 of the plan. The University of Tasmania has expressed interest in establishing a summer educational program using station facilities; dialogue between the University and the AAD and PWS has been encouraged. The Bureau of Meteorology is also interested in continuing its research and monitoring programs, and the international geological community is keen to continue research programs. Educational tourism interest in the reserve is likely to grow and continue into the future.

The major pressures on the reserve are a result of human interest and occupation. This plan aims to provide substantive protection to the natural and historical values of the reserve and to repair past damage by human activities. To contribute to the achievement of these aims, the reserve has been declared a restricted area under the *National Parks and Reserves Management Act 2002* and authorisation from the Director of National Parks and Wildlife is required to enter the reserve. This plan establishes three management zones. The first zone covers the AAD research station on the Isthmus where accommodation, workshops, laboratories, stores and support facilities have been established for over 50 years. The second zone covers the rest of the terrestrial reserve and adjacent sea stacks where limited facilities and experimental sites have been or may be established. The third zone covers the marine environment to the limit of state waters, three nautical miles from low-water mark.

Special Management Areas, such as Bishop and Clerk Islets, Judge and Clerk Islets and the Caroline Cove/southern peaks area, may be designated within any of these zones to further manage human access, especially during the breeding season or when necessary for protection of natural and historic cultural heritage values.

The reserve is of great public interest and educational value. Although tourism and recreation are not objectives of management for Tasmanian nature reserves, controlled tourism for educational purposes is the only form of tourism permitted in this reserve. Tourism management areas have been designated in each zone to provide limited access for educational tourism purposes.

Off-reserve public education programs through various media will continue to be encouraged. Tasmania's role in managing the island will be publicised and promoted to assist the promotion of the state as a base for Antarctic activity, in accordance with the State Government's Antarctic Policy.

The plan also describes the protected marine areas; i.e. the eastern waters of the World Heritage Area from 3 to 12 nautical miles included in the Macquarie Island Marine Park. While this plan cannot bind the Australian Government, a cooperative and complementary approach to the management of adjacent protected marine areas will be encouraged.

The geological values, which were the focus of the World Heritage listing of the reserve, will be protected due to their global significance. Scientific research interest in the reserve is high because it is the only place in the world where rocks from up to 6 kilometres below the ocean floor are exposed above sea level. Current knowledge of the Earth's oceanic crust has been limited to the depths to which drilling can occur, considerably less than 6 kilometres.

As of June 2003, the reserve protects 16 species of fauna and one plant species that are listed in the Schedules of the Tasmanian *Threatened Species Protection Act 1995*. Five other species are currently under review for inclusion. In 2002, Macquarie Island Nature Reserve was listed as habitat critical to the survival of two albatross species on the Register of Critical Habitat under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBCA). All four species of albatross that breed in the reserve are vulnerable to extinction, as are the southern elephant seal and subantarctic fur seal. Research on these species will continue to be focused on monitoring the Macquarie Island populations and their foraging requirements.

One of the highest conservation priorities in the reserve is the eradication of rabbits, rats and mice from the island. These alien species are identified as causing extensive impacts on the biodiversity and landscape of the reserve. Research programs into the biology, ecology and management of alien species in the reserve will continue. Where feasible, practical and desirable, control programs will continue to be undertaken. Stringent precautions will be implemented to prevent further accidental introductions of alien species.

The identification, interpretation and, where considered necessary, conservation of historic cultural heritage will be given high priority. Further studies and/or conservation work will be carried out where necessary for the preservation of historic cultural heritage.

This management plan replaces the *Macquarie Island Nature Reserve Management Plan 1991*. It considers and incorporates planning and public consultation undertaken since 1996 when the reserve was first nominated for World Heritage listing. It also considers and incorporates consultation undertaken since 1999 for the marine component of the reserve and the preparation of this new management plan.

This management plan has been prepared in accordance with the Tasmanian *National Parks and Reserves Management Act 2002* and in accordance with the EPBCA and its Regulations, in particular Schedule 5, which sets out Australian World Heritage Management Principles. These principles promote national standards of management, planning, environmental impact assessment, community involvement and monitoring for all of Australia's World Heritage properties in a way that is consistent with Australia's obligations under the World Heritage Convention.

This plan is divided into two major sections. Part A provides an overview of the reserve, its legislative context and a description of the values of the reserve. Part B provides the management vision, objectives, policies and prescriptions for the reserve. The appendices provide further useful information for management of the reserve.

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Part A - Background to the Management Plan

The following three sections provide an overview and description of the reserve to inform Part B, the statutory management policies and prescriptions for the plan.

Section 1 describes the location and regional context of the reserve, its history of reservation and a summary of its values as a World Heritage Area, a biosphere reserve, and a nature reserve. This section also presents a brief history of human activity in the reserve and a short description of the management plan.

Section 2 describes the management framework for the reserve in view of its international, national, state and local context. It also describes the Australian and state legislation that applies to the reserve and its management.

Section 3 describes the natural and historic cultural heritage values of the reserve. While not exhaustive, this material is intended to provide the necessary background for the statutory prescriptions and policies that follow in Part B of the plan, and also to provide a general reference source for future management and scientific personnel in the reserve.

1 An Overview of the Reserve

1.1 Location, Regional and Global Context

The Macquarie Island Nature Reserve comprises all of those areas of Crown land including Macquarie Island, Bishop and Clerk Islets, Judge and Clerk Islets, all adjacent offshore islands, rocks and reefs, and the surrounding seas extending to the limit of state waters (3 nautical miles), situated in the Southern Ocean in the vicinity of longitude 158˚55' E, latitude 54˚30' S. The reserve comprises 87,500 hectares in total as shown on Central Plan Register 5330, filed and registered in the Central Plan Office, Department of Primary Industries and Water (DPIW). The location of the island is shown on Map 1 (Southern Ocean) and Map 2 (Regional Location). The outer boundary of the reserve from 3 nautical miles (nm) adjoins Australian waters to 12 nm, and the eastern boundary of the reserve is contiguous with the Macquarie Island Marine Park (Map 3). All of the State nature reserve and the Australian waters from three nm to 12 nm together comprise the Macquarie Island World Heritage Area (see Map 4).

Macquarie Island Nature Reserve and World Heritage Area is one of two Australian subantarctic island groups. The other is the Heard Island and McDonald Islands group, an Australian External Territory (see Map 1) and also a World Heritage Area. The Australian Antarctic Division supports a research station on Macquarie Island and supports periodic research expeditions to Heard and MacDonald Islands.

Macquarie Island Nature Reserve is part of Tasmania and is included in the Huon Valley Municipality. Macquarie Island is approximately 1500 km SSE of Tasmania and 1100 km SW of New Zealand. The New Zealand subantarctic islands, the Auckland Islands (640 km NE) and Campbell Island (700 km ENE), are the nearest landmasses to the reserve (Map 2) and share biogeographic connections with Macquarie Island.

There are 22 subantarctic island groups in the southern oceans lying between the Subtropical and Antarctic Polar Frontal Zones. With very few exceptions, these islands have been modified to some degree by human activities. Nevertheless, these islands and their surrounding waters are the 'last bastions of nature in a world beset by massive and rapid change because of human activity' Department of Conservation (DOC 1998). The marine birds and mammals of the Southern Ocean ecosystem depend on these island groups and their waters for survival.

1.2 Reservation History

Macquarie Island was included as part of Van Diemens Land when it was proclaimed a separate colony in 1825 and then became part of the State of Tasmania. In 1933, largely due to the efforts of Sir Douglas Mawson, it was made a wildlife sanctuary under the *Animals and Birds Protection Act 1928* (*Tasmanian Government Gazette*, 23 May 1933). When the *National Parks and Wildlife Act 1970* came into force in 1971, Macquarie Island became a conservation area under the Act. On 14 June 1972 it was reproclaimed a

state reserve under the same Act (Statutory Rules 1972, No. 152) and was called the Macquarie Island Wildlife Reserve.

In 1977 it was declared a Biosphere Reserve under United Nations Educational, Scientific and Cultural Organisation's (UNESCO) Man and the Biosphere Program and was also listed on the Register of the National Estate. In 1978, Macquarie Island State Reserve was extended to low-water mark including the offshore islands and formally named Macquarie Island Nature Reserve (Statutory Rules 1978, No. 121). The reserve was declared a restricted area in 1979 with the result that intending visitors have been required to obtain access authorisation from the managing authority. The Director of National Parks and Wildlife (the Director) is the managing authority.

In December 1997 the reserve and its surrounding waters to 12 nm were inscribed on the World Heritage List as the Macquarie Island World Heritage Area. Australia's World Heritage Areas are required to be managed in accordance with Australian World Heritage Management Principles as set out in Schedule 5 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBCA) (see Section 3.4).

In 2000 the Macquarie Island Nature Reserve was extended to the limit of state waters, 3 nm from low water mark around the island and outlying islets. The land under the sea, and all flora and fauna, including fish and marine plants, are completely protected as an integral part of the terrestrial reserve and therefore are part of the restricted area. Written authority is required from the Director to enter the waters of the reserve (see Section 6.3).

The Australian Government proclaimed the Macquarie Island Marine Park in 1999 under the *National Parks and Wildlife Conservation Act 1975* to protect the unique and vulnerable marine ecosystems of the south-eastern portion of the Macquarie Island biogeographic province. The Macquarie Island Marine Park Management Plan (2001) was prepared in accordance with the EPBCA and applies to the waters from 3nm to 200 nm as shown on Map 3. The Department of Environment and Heritage is the Australian government's managing authority for the marine park.

In 2002, Macquarie Island Nature Reserve was listed on the Register of Critical Habitat under the EPBCA as habitat critical to the survival of two of the reserve's albatross species (grey-headed and wandering albatrosses), listed nationally as vulnerable to extinction.

1.3 Summary of Values

The following is a summary of the values identified in the designations of the reserve as a World Heritage Area (WHA), a biosphere reserve, a National Estate property and a nature reserve. These designations are complementary and illustrate local, national and international recognition of the importance of the reserve for conservation of biodiversity and cultural heritage values. The legislative context for management is provided in Section 2, and detailed descriptions of these values are provided in Section 3. The vision and objectives for management are provided in Section 4. The policies and prescriptions to protect and conserve these values and to achieve the objectives of management are provided in Sections 5, 6, 7 and 8. The appendices, though not part of the statutory plan, provide further information useful for management of the reserve for these values.

1.3.1 World Heritage Values

Macquarie Island Nature Reserve was inscribed on the World Heritage List in 1997 on the basis of its outstanding natural universal values. The following is taken from the listing statement (Department of Environment, Sport and Territories 1996). The reserve met two of the four criteria for listing as a natural site:

- as an outstanding example representing major stages of the earth's evolutionary history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features; and

- containing superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.

Macquarie Island provides important and highly significant evidence of the rock types found in the oceanic crust. These extend from the upper mantle, approximately 6 km below the sea floor, to the rocks that are currently forming on the sea floor. These rocks are typical of mid-oceanic ridge environments where new crust is being formed and are interpreted as providing clear evidence for plate tectonics and continental drift. It is the only island in the world composed entirely of oceanic crust. The World Heritage values given in the listing statement that met the first criterion above included:

- above sea-level evidence of rock sequences formed during sea-floor spreading and tectonic processes that occur along a mid-oceanic spreading centre;

- the only known example of two oceanic plates colliding, producing a ridge and island feature at a major strike slip plate boundary;

- the only known example of oceanic crust being uplifted as a result of transpression at an ocean–ocean plate boundary;

- the only known example of an ophiolite complex (see next dot point) in the process of being formed and currently in its original geological setting in a major ocean basin;

- a near-pristine example of an ophiolite (a distinctive assemblage of mafic to ultramafic rocks – rocks from the upper mantle of the earth's oceanic crust, which lies 5 to 6 km below the ocean floor);

- evidence of the structure, processes of formation and geochemistry of lower layers of Earth's lithosphere providing sequences from all crustal levels down to 6 km;

- an example of the structure and composition of both the oceanic crust and the upper mantle;

- the only known example of oceanic crust formed by sea-floor spreading and active uplift that is accessible from above sea level and still actively forming, undeformed, and uncontaminated;

- evidence of the exposure of a segment of a major active plate boundary in an oceanic setting;

- evidence of continuing tectonic and structural processes, including frequent and large earthquakes and dramatic uplift; and
- an example of the reversal of geological processes, from tectonic plates moving apart and then reversing movement to collide.

Macquarie Island is of exceptional natural beauty and aesthetic importance and contains superlative natural phenomena. The World Heritage values given in the listing statement (Department of Environment, Sport and Territories 1996) that met the second criterion above included:

- spectacular steep escarpments;
- extensive peat beds;
- large numbers of lakes, tarns and pools;
- dramatic changes in vegetation cover due to climatic conditions;
- extensive congregations of wildlife, including royal and king penguins, especially during the breeding season;
- majestic albatross (4 species) nesting on cliffs;
- impressive colonies of elephant seals, allowing ability to view breeding and mating behaviour; and
- the remote, dramatic and essentially undisturbed location.

The World Heritage values of the reserve are described in further detail in Section 4 of this management plan.

1.3.2 Biosphere Reserve Values

Macquarie Island Nature Reserve was listed in 1977 as a biosphere reserve under the UNESCO Man and the Biosphere program. It is the only biosphere reserve in the subantarctic biogeographic region. It is extremely important in the conservation of biodiversity and cultural heritage of the region. It has a history of human intervention since its discovery in 1810, from exploitation of elephant seals and penguins for oil to its history of scientific research. Scientific research and management activities range from threatened species research and monitoring, and alien species control, to global monitoring for climate change and monitoring of human impact. Educational tourism and media continue to raise public awareness about the conservation values of the reserve.

1.3.3 Critical Habitat Values

Macquarie Island Nature Reserve, Albatross Island, The Mewstone and Pedra Branca Islands, all part of Tasmania, were listed in 2002 on the Register of Critical Habitat under the EPBCA. These islands constitute the only suitable breeding habitat for three species of albatross listed nationally as vulnerable to extinction. If these habitats were lost, it

would have a severe effect on these species as they are extremely site-faithful and the populations currently breeding on these islands are unlikely to breed elsewhere.

1.3.4 National Estate Values

Macquarie Island was listed on the Register of the National Estate in 1977 as a natural site of very high biogeographic significance. It is located on the Antarctic Polar Frontal Zone, where the ranges of many Antarctic and more northerly species meet and, as a result, many species are at the northerly or southerly limit of their range. It is an excellent representative of a subantarctic island group, with good examples of plant communities and unusual landforms and provides critical breeding, moulting and foraging habitat for its plentiful fauna. Its geological values are described above and these contributed directly to its National Estate listing. It has been of great importance as a scientific research site since the turn of the 20th century and is significant in the history of the discovery and exploration of Antarctica. As an early industrial site, the remains of the sealing and oiling tryworks on the island are of outstanding national historical and archaeological significance.

1.3.5 Nature Reserve Values

A nature reserve under the Tasmanian *Nature Conservation Act 2002* is a class of reserved land that contains natural values that contribute to the biological diversity or geological diversity of the land, or both, and are unique, important or have representative value. Along with the World Heritage values listed above, the following values contribute to its importance as a nature reserve as set out in Schedule 1 of the Act:

- It is a unique terrestrial feature with strong links to the marine environment. It has a complex geological history and significant ongoing geological processes.
- The island is unique in that its present geomorphology shows features of marine erosion that has progressively affected its whole surface during uplift. This complements and is a consequence of its past development and continued evolution as an emergent part of the sea floor.
- Macquarie Island has never been connected to any other landmass and the biota of the reserve has resulted from colonisation by long-distance dispersal and in a few instances by human transport.
- There are an estimated 3.5 million breeding seabirds and 100,000 breeding seals in the reserve, including 13 species of seabirds and three species of seals that are listed under Tasmanian and/or Australian threatened species legislation as vulnerable to extinction.
- Several of the fauna species that breed on the island do not breed anywhere else in the region. The reserve is considered to be the eastern extremity of the subantarctic terrestrial region.
- The reserve is an essential land base for many species of marine birds and mammals during moulting and breeding stages.
- The native fauna of the reserve and the marine flora and fauna around it have strong affinities with other subantarctic islands.

- Although the terrestrial flora has a significant Australasian component it still contains subantarctic elements found nowhere else in the area.

- The marine zone includes the intertidal and shallow-water habitats and their fauna and flora. These are some of only a few shallow-water habitats in thousands of square kilometres of ocean (the nearest land is the Auckland Islands group, 640 km to the northeast).

- The marine zone includes the benthic habitats in the vicinity of the island, which have not been subject to impact from exploratory benthic trawling.

- The marine zone protects access to the island for the vast numbers of seabirds and seals that depend on the island for breeding and moulting. Although most species travel further out to sea for most of their foraging, the zone protects the near-shore foraging areas and nursery areas for some species.

- The marine zone includes all the benthic foraging areas of the island's endemic sub-species of cormorant and over half the foraging grounds of the island's gentoo penguin population.

- The marine zone includes active geological and geomorphological processes such as accumulation of deposits from the land, slope movements and possibly turbidity flows. The zone includes the steep slopes on the eastern side of Macquarie Island leading down to the Macquarie Trough, which is located within the Macquarie Island Marine Park.

These are the values that contribute to its status as a nature reserve. The reserve also has important historic heritage values and scientific values, described in Sections 3 and 6.8 of this plan.

1.4 History of Human Activity to the Present Day

Macquarie Island was discovered on 11 July 1810 by the sealing brig *Perseverance,* commanded by Captain Fredrick Hasselburg. He named the island after the then Governor of New South Wales, Lachlan Macquarie. The discovery led directly to the commercial exploitation and near-extinction of much of the island's wildlife. This exploitation, firstly of fur seals for their skins, then of elephant seals and penguins for oil, continued intermittently until 1919 when the last oil-gathering gang left the island (Cumpston 1968; Townrow 1988, 1989). Between 1810 and 1919 several shore stations were established on the island and during that period at least 11 ships were wrecked at Macquarie Island and in its vicinity (Nash 2003). The first shore stations represent some of the earliest industrial sites in Australia. Remains of the shore stations and wrecks are still evident today (Map 4).

With discovery and commercial exploitation came the almost inevitable introduction of alien species, many of which still cause major problems for biological conservation on the island (see Table 1 and Section 3.11) (Jenkin *et al.* 1981; Brothers & Skira 1984; Copson 1984, 1986, 1995; Brothers & Copson 1988).

In 1820 a Russian expedition led by Thaddeus von Bellingshausen visited the island and made the first known collections of flora and fauna (Debenham 1945). Over the next 90 years several expeditions visited the island and made collections of specimens (Appendix 1). The first attempts at systematic collecting and studies were carried out by Scott (1881), Hamilton (1885) and Burton (Campbell 1901), all of whom visited the island with oil gatherers from New Zealand.

During 1911-14 the Australasian Antarctic Expedition (AAE), under Douglas Mawson, established a station on the island. Studies were carried out into the botany, zoology, geology and meteorology of the area together with magnetic observations and detailed mapping. The AAE Scientific Reports series includes many papers resulting from fieldwork conducted on the island over this period (Mawson 1922). It was largely due to Mawson's efforts that oil-gathering was stopped and the island was made a wildlife sanctuary in 1933.

In 1948 the Australian Government established an Australian National Antarctic Research Expeditions (ANARE) station on the island. The station is operated by the Australian Antarctic Division (AAD), a division of the Department of Environment and Heritage, which provides support for multi-disciplinary research, observation and management programs undertaken by Australian, state and foreign government agencies, Australian and foreign universities, as well as other institutions and private individuals.

The Tasmanian National Parks and Wildlife Service commenced an active role in the management of the reserve in 1972. The Biodiversity Conservation Branch of DPIW and the Parks and Wildlife Service of the Department of Tourism, Arts and the Environment (DTAE) continue to conduct research and management programs in the reserve. The Macquarie Island Research Assessment Group (see Section 6.7), comprising scientific, planning and management staff from both departments, works together to assess proposals and to ensure research and management activities undertaken in the reserve comply with this management plan.

Human activity in the reserve currently includes management programs, scientific research, monitoring programs and their support, and educational tourism. Intensive control and eradication programs are being carried out for alien species and long-term studies have been instigated to monitor changes in the status of native and alien wildlife resulting from these programs. Continuation of these control, eradication and monitoring programs is one of the highest priorities for the reserve. Research into the conservation status of threatened bird and seal species to assist in long-term management is also a priority. Research and monitoring programs are undertaken to study the impacts of global climate change on vegetation and geodiversity. Geological research is undertaken to assist in understanding global earth processes and the geological evolution of the island. Upper atmospheric physics and meteorological observations, which have been undertaken for more than 50 years, are of global monitoring importance. Educational tourism is carefully controlled, but will continue to be encouraged to increase public awareness and understanding and to provide funding for management of the reserve.

Exploratory trawl fishing commenced in waters around Macquarie Island in 1994 by a single vessel. Reduced allowable catches over subsequent years and closure of the Aurora Trough grounds in 1999 has resulted in very limited fishing activity to date. Fishing has been prohibited in the marine component of the state nature reserve since the extension to the terrestrial reserve was declared.

1.5 The Management Plan

This management plan has been prepared for the Macquarie Island Nature Reserve under the Tasmanian *National Parks and Reserves Management Act 2002* (NPRMA*)*. This plan replaces the Macquarie Island Nature Reserve Management Plan 1991 and takes account of changes in reserve size, tenure, governing legislation, World Heritage status and adjacent Australian Government protected marine areas.

The Director and his delegates will give effect to this management plan in accordance with s. 30(1)(a) of the NPRMA, subject to the provision of funding and sufficient resources to implement the provisions of the plan.

While this plan does not bind the Australian Government, sections 322 and 339 of the EPBCA require the Australian Government to take all reasonable steps to ensure that it exercises its powers and performs its functions in a way that is not inconsistent with this plan. The AAD and the Bureau of Meteorology are the major Australian Government agencies currently operating in the reserve.

The purpose of this plan is to provide an integrated policy framework for the conservation and protection of the values of the reserve and for management of human use of the reserve. It will remain in effect for 7 years after it has been approved by the Governor, or until it is replaced by a new management plan.

2 Management Framework

Macquarie Island Nature Reserve is unusual in that the World Heritage designation covers all of the nature reserve as well as Australian waters to 12 nm. This statutory plan, prepared under state legislation, addresses the management of both areas but is only applicable to the nature reserve, which includes waters to 3nm. The Macquarie Island Marine Park Management Plan 2001 covers the waters of that protected marine area east of the reserve from 3nm to 200 nm, within Australia's Exclusive Economic Zone (EEZ) around Macquarie Island.

It is sensible that one plan be prepared for both the state reserve and the World Heritage Area (WHA), recognising that while it legally does not apply to the waters between 3 nm and 12 nm, it is understood that management of all the protected areas will be cooperative and complementary. To these ends, a Memorandum of Understanding between the Australian Government and the State of Tasmania has been developed in regard to management of this part of the World Heritage Area (Appendix 8).

2.1 International Context

The following international conventions and programs provide a context for the protection and management of Macquarie Island and for management of human activities and occupation of the reserve. Australia is a signatory to all of the conventions and programs given below.

World Heritage Convention

The Convention for the Protection of the World's Cultural and Natural Heritage (the World Heritage Convention) was adopted by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) General Conference in 1972 and came into force in 1975. As of March 2003, 176 countries are State Parties to the Convention. There are more than 730 properties on the World Heritage List, including 16 in Australia. Other subantarctic island groups on the World Heritage List include Australia's Heard and McDonald Islands, New Zealand's subantarctic islands and the United Kingdom's Gough Island.

The Convention is considered the most successful global instrument for the protection of cultural and natural heritage. It aims to promote cooperation among nations to protect heritage from around the world that is of such outstanding universal value that its conservation is important for current and future generations. State Parties to the Convention commit themselves to ensure the identification, protection, conservation, presentation and, where necessary, rehabilitation of World Heritage properties. This management plan aims to provide the appropriate legal, scientific, technical, administrative and financial measures necessary for the identification, protection, conservation, presentation and rehabilitation of this heritage.

In order to provide an intergovernmental forum for Australia's World Heritage properties, consultative that provide independent and objective advice on management are usually

established. These committees are either community consultative committees, scientific and technical committees, or a combination of the two types, such as the committee established for the Tasmanian Wilderness WHA. These committees are made up of national and international experts in relevant fields and include Australian Government and State Government representatives. Such a committee is proposed for Macquarie Island Nature Reserve and World Heritage Area (see Section 7.3).

UNESCO Man and the Biosphere Program

Macquarie Island Nature Reserve is a listed biosphere reserve under this program. It is one of Australia's 11 biosphere reserves and the only one located in the Southern Ocean. Biosphere reserves are areas of terrestrial and coastal/marine ecosystems or a combination thereof, which are internationally recognised and form part of a worldwide network. This network is a tool for conservation of biological diversity and sustainable use; in the case of Macquarie Island, for scientific research, education and global monitoring programs, as well as the management and conservation of threatened species.

Convention on Biological Diversity

The Convention on Biological Diversity was negotiated under the auspices of the United Nations Environment Programme (UNEP) in 1992. Over 170 parties are signatories. The three goals of the Convention are to promote the conservation of biodiversity, the sustainable use of its components and the fair and equitable sharing of benefits arising out of the utilisation of genetic resources. It requires parties to pursue these goals in part through the establishment of a system of protected areas such as Macquarie Island Nature Reserve.

Through membership in Botanic Gardens Conservation International, the Subantarctic Plant House at the Royal Tasmanian Botanical Gardens contributes to the Global Strategy for Plant Conservation.

Agreement on the Conservation of Albatrosses and Petrels (ACAP)

On 19 June 2001, seven fishing nations (New Zealand, Australia, Brazil, Peru, Chile, France and the United Kingdom) signed a new conservation agreement to protect species of migrating albatrosses and petrels. South Africa and Ecuador have also recently committed to the agreement. The agreement was initiated by Australia in 1997 and developed under provisions of the Convention on Migratory Species of Wild Animals. It provides for cooperative research and conservation measures, and supports the implementation of the actions elaborated in the Food and Agricultural Organisation (FAO) International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries. Significant populations of four species of albatross and at least nine species of petrels are protected in Macquarie Island Nature Reserve and adjacent marine protected areas, thereby contributing to international conservation measures. Long-term research and monitoring programs on albatrosses and petrels are also conducted in the reserve. Macquarie Island is the only breeding habitat under Australian jurisdiction for wandering albatross and grey-headed albatross, both species that are listed as vulnerable to extinction under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBCA) (see Section 3.10.3).

Bonn Convention

The Convention on the Conservation of Migratory Species of Wild Animals (the CMS or Bonn Convention) is directed toward the conservation and management of migratory species (including waterfowl and other wetland species), and promotion of international measures for their conservation including cooperation, research and habitat conservation. The Macquarie Island Nature Reserve and WHA contributes to these measures by providing protection and habitat conservation for sperm whales, killer whales, wandering albatrosses, light-mantled sooty albatrosses, northern and southern giant petrels and grey petrels.

Ramsar Convention

The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) is directed toward the conservation and wise use of wetland habitats, which are of crucial importance in achieving a positive conservation status for many species of wetland fauna and flora, including migratory species, especially waterfowl. In 1997, a Memorandum of Understanding was signed by the Secretariats of the Bonn and Ramsar Conventions. Consideration is currently being given to nomination of Macquarie Island Nature Reserve for listing as a Ramsar site. Schedule 6 of s. 10 of the EPBCA provides principles for managing Ramsar sites.

JAMBA and CAMBA

The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction (JAMBA) and the Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) apply to Macquarie Island Nature Reserve in that several listed species breed in the reserve.

Convention for the Conservation of Antarctic Seals

The Convention for the Conservation of Antarctic Seals, signed in 1972, protects all seals in Antarctic waters (south of 60˚ south), including southern fur seals (*Arctocephalus* spp.) and southern elephant seals. The convention is relevant to Macquarie Island in terms of the Antarctic foraging grounds of elephant seals breeding on the island.

Convention on the Conservation of Antarctic Marine Living Resources

The Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) came into force in 1982 as part of the Antarctic Treaty System, in pursuance of the provisions of Article IX of the Treaty. The aim of the convention is to conserve the marine life of the Southern Ocean. It was established mainly in response to concerns that an increase in krill catches in the Southern Ocean could have a serious effect on populations of krill and other marine life; particularly on the birds, seals and fish which depend mainly on krill for food. The reserve and the Macquarie Island Marine Park lie just outside the area covered by the convention. Recognising that fishing activities in areas adjacent to the CCAMLR boundary could affect conservation outcomes within the convention area, the commission called upon member states with jurisdiction in adjacent

areas to ensure any harvesting is conducted in a responsible manner. Macquarie Island is considered to be an 'adjacent area' and the management measures and objectives adopted for the Patagonian toothfish fishery are consistent with, or exceed, the approach CCAMLR takes for similar fisheries within the CCAMLR boundaries (EA 2001).

International Convention for the Regulation of Whaling

The International Convention for the Regulation of Whaling was signed in Washington DC on 2 December 1946. The purpose of the convention is to provide for conservation of whale stocks and to protect all species of whale from overfishing. It provides for the complete protection of certain species, for promoting relevant research and for designating specific areas as whale sanctuaries. Attempts to make the entire Southern Ocean a whale sanctuary have failed to date, although Australia has declared its entire EEZ, including that around Macquarie Island, a whale sanctuary (National Oceans Office [NOO] 2001).

International Convention for the Prevention of Pollution from Ships

The International Convention for the Prevention of Pollution from Ships 1973 (MARPOL Convention) and its annexes are the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively. Annex 5 of the convention, which deals with the discharge of rubbish into the sea, is given additional effect by Tasmanian and Australian Government legislation in that plastics may not be discharged into any waters within the EEZ around Macquarie Island. This is particularly important for protection of the marine mammals and birds of the reserve.

2.2 National Context

Australian World Heritage Areas

Macquarie Island Nature Reserve and the waters to 12 nm comprise the Macquarie Island WHA. It is one of 16 properties in Australia of international natural and cultural significance. These are: Kakadu National Park; the Great Barrier Reef; the Willandra Lakes; the Lord Howe Island Group; Central Eastern Rainforest Reserves; Uluru-Kata Tjuta National Park; the Wet Tropics of Queensland; Fraser Island; Shark Bay; the Australian Fossil Mammal Sites (Riversleigh and Naracoorte); Heard and McDonald Islands; the Greater Blue Mountains Area; Purnululu, Royal Exhibition Building and Carlton Gardens, the Bungle Bungles; and the Tasmanian Wilderness WHA.

This management plan has been prepared in accordance with the EPBCA and its Regulations, in particular Schedule 5, which sets out Australian World Heritage Management Principles. These principles promote national standards of management, planning, environmental impact assessment, community involvement and monitoring for all of Australia's World Heritage properties in a way that is consistent with Australia's obligations under the World Heritage Convention.

Application will be made to have this management plan accredited by the Australian Government under the EPBCA. Section 3 details the principles and the sections of this plan that give effect to the World Heritage Management Principles.

Australian Biosphere Reserves

Macquarie Island Nature Reserve is one of 11 biosphere reserves in Australia that are representative of global biogeographical regions and it is the only one in the Southern Ocean. The addition of the Macquarie Island Marine Park provides a more functional biosphere reserve because it now includes the marine environment and provides a core area buffered by a surrounding multiple use area (2001).

Section 3 of this plan provides details of the principles for management of biosphere reserves and how this plan complies as set out in Schedule 7 of the Regulations of the EPBCA.

Australian Antarctic Program

The Australian Antarctic Division (AAD), a division of the Department of Environment and Heritage, administers Australia's Antarctic program from its offices in Kingston, near Hobart. The AAD conducts and supports science programs in the Antarctic and subantarctic, represents Australia at international meetings on Antarctic affairs and administers Australian territories in the region. Australia's Antarctic program embraces the activities of the AAD and other government agencies, such as the Bureau of Meteorology, the Ionospheric Predictions Service, Geoscience Australia, and other non-government bodies and individuals, such as the Cooperative Research Centre for Antarctic and Southern Ocean Ecosystems at the University of Tasmania (AAD 2000).

Australia's Oceans Policy

Australia's Oceans Policy and regional marine planning process provides a framework for the exploration, use, protection and enjoyment of the marine environment. It recognises the need to protect the biological diversity of the marine environment while promoting and encouraging sustainable, secure marine industries. A resource assessment of the Macquarie Island Large Marine Domain (NOO 2002) was prepared, which contributed to the South-east Regional Marine Plan. The resource assessment report provides an overview of resource use in the past and potential future uses of the Macquarie Island region.

National Representative System of Marine Protected Areas (NRSMPA)

Macquarie Island Marine Park, managed by the Australian Government, is part of the NRSMPA, a comprehensive, adequate and representative system of marine protected areas to contribute to the long-term ecological viability of marine systems, to maintain ecological processes and protect Australia's biodiversity (EA 2001). The main purpose of the marine park is to protect its conservation values from human disturbance. It also helps to meet Australia's obligations to protect the needs of threatened species, migratory species and species vulnerable to disturbance.

Burra Charter

The Australia ICOMOS Charter for the Conservation of Places of Cultural Significance (the Burra Charter) was adopted by Australia ICOMOS (the Australian National Committee of the International Council on Monuments and Sites) in 1979. The 1999 version of the Charter is the current version. The Charter establishes nationally-accepted principles for those who provide advice, make decisions about, or undertake works on places of cultural significance, including owners, managers, conservators and custodians. The Burra Charter's principles guide management of the cultural and historical heritage sites in Macquarie Island Nature Reserve and WHA (see Section 5.9).

National Recovery Plans, Action Plans and Threat Abatement Plans

A number of national recovery, action and threat abatement plans have been produced by the Department of Environment and Heritage that are relevant to the protection and conservation of threatened species and the management of alien species of Macquarie Island. These plans include:

- The Recovery Plan for Albatrosses and Giant Petrels 2001
- Action Plan for Australian Cetaceans 1996
- The Recovery Plan for the Southern Elephant Seal and Subantarctic Fur Seal (in preparation)
- The Action Plan for Australian Birds 2000
- The Action Plan for Australian Seals 1999
- The Threat Abatement Plan for Predation by Feral Cats 1999
- The Threat Abatement Plan for Competition and Land Degradation by Feral Rabbits 1999
- The Threat Abatement Plan for the Incidental Catch (or Bycatch) of Seabirds During Oceanic Long Line Fishing Operations 1998
- Conservation Overview and Action Plan for Australian Threatened and Potentially Threatened Marine and Estuarine Fishes 2002

2.3 State and Local Context

The following strategies and documents provide a state and local context for the management, protection and conservation of the natural and historical values of the reserve.

Tasmania's Antarctic, Sub-Antarctic and Southern Ocean Policy Framework

This framework was launched by the Premier of Tasmania in 2001 and includes 33 specific actions designed to enhance Tasmania's reputation as an important Antarctic gateway for members of the international Antarctic community. Most of these actions are now complete and the State Government has since developed a new Antarctic Policy, which was released in 2004.

Tasmania Together

Tasmania *Together* is a community-owned and driven 20-year social, environmental and economic plan for Tasmania. A thorough community consultation process begun in 2000 led to the creation of the Tasmania *Together* vision and its 24 associated goals and 212 benchmarks. Many of the targets, benchmarks and indicators are concerned with conservation and protection of the cultural and natural heritage of Tasmania, as well as recognising the economic benefits that can accrue to the state from doing so.

Legislation and the commitment of the State Government to the conservation and protection of the reserve, to reversing the decline of threatened species in the reserve, and to the promotion of educational tourism to the reserve, all contribute to the achievement of the aims of Tasmania *Together*. Progress towards achievement of these aims is encouraged and monitored by an independent statutory authority, the Tasmania *Together* Progress Board.

The Tasmanian Natural Resource Management Framework

The Tasmanian Natural Resource Management Framework has been developed to provide the state with a systematic way of integrating natural resource management, to ensure consistency, efficiency and improved natural resource outcomes. It provides the administrative system by which the Tasmanian Government coordinates and integrates the activities of the wide range of entities that are involved in the management of natural resources in the state.

Macquarie Island Nature Reserve and WHA is part of the Southern Natural Resource Management (NRM) Region, as established under the *Natural Resource Management Act 2002*. The main task of the Southern NRM Regional Committee is to develop and implement a regional strategy, to be accredited by the Tasmanian and Australian Governments.

The Regional Committee includes representation from the Parks and Wildlife Service (PWS). Nature reserves and WHAs are to be taken into account when identifying the region's natural values and its NRM priorities. The *Natural Resource Management Act 2002* does not affect the statutory processes for establishing and managing nature reserves but, because of the regional committee's role in setting priorities and recommending funding, it is to be kept informed of all significant management proposals for Macquarie Island.

Tasmanian Reserve Management Code of Practice

The Tasmanian Reserve Management Code of Practice 2003 (PWS et al. 2003) provides operational standards and practices for management activities in Tasmanian reserves declared under the *Nature Conservation Act 2002*. This code also sets out the assessment and approval processes for various activities in reserves (see Section 6.3). Macquarie Island will be managed in accordance with the operational standards and practices set out in the Code.

Threatened Species Strategy for Tasmania 2000

This strategy describes the state's approach to conserving threatened species through the development of threat abatement plans. These plans address key threatening processes such as the impact of rabbits on Macquarie Island seabirds and vegetation and, in some cases, address the threats to priority threatened species, such as the threat from long-line fishing on the albatrosses of Macquarie Island.

Tasmanian Nature Conservation Strategy

The Nature Conservation Strategy was produced by the State Biodiversity Committee, a broadly based group of experts established in 2000. Tasmania's Nature Conservation Strategy (DPIWE 2002) covers a wide range of issues and makes 64 recommendations, many of which apply to reserves such as Macquarie Island. It complements a number of other government initiatives, including Tasmania *Together*, the State of Environment Report and the Natural Resource Management Framework.

Huon Valley Municipal Planning Scheme

Macquarie Island is included in the Huon Valley municipality. To date the council has had little involvement in management and planning for the reserve. A 2001 amendment to the *Land Use Planning and Approvals Act 1993* provides for that Act to apply to all Tasmanian reserves on a date to be proclaimed (see Section 6.3).

2.4 Legislative Context

Australian Government Legislation

The Federal *Environmental Protection and Biodiversity Conservation Act* 1999 (EPBCA) came into force in July 2000 and provides protection for matters of National Environmental Significance (NES) and for actions on Australian Government land or taken by an Australian Government agency. The NES matters that are relevant to Macquarie Island include the values of the World Heritage property, listed threatened and migratory species, the Australian Government marine area and potentially actions taken by an Australian government agency. Substantial criminal and civil penalties can apply for breaches of the Act.

Persons considering taking an action that may have a significant impact on a protected matter should examine the information about the EPBCA from the Department of the

Environment and Heritage website at http://www.deh.gov.au/epbc/ or by contacting that Department. Information includes detailed descriptions of the matters protected, the thresholds applied by the Department regarding whether significant impacts are likely and the scope of actions that may require approval. See Section 6.3, which sets out in detail the approach to be followed.

In the case of Tasmania, a bilateral agreement between the state and the Australian Government was signed on 15 December 2000, providing for the accreditation of the Tasmanian Government's primary environmental impact assessment (EIA) processes. This agreement aims to minimise duplication, strengthen intergovernmental cooperation and promote a partnership approach to environmental protection and biodiversity conservation. This means that any actions that may have a significant impact on matters of national environmental significance may be assessed using the environmental impact statement process under the Tasmanian *State Policies and Projects Act 1993* and the development proposal and environmental management plan process under the Tasmanian *Environmental Management and Pollution Control Act 1994*, if the nature of the action would normally be assessed under these Acts. It is important to note that the approval of the Australian Environment Minister is still required before such an action can proceed. These Tasmanian EIA processes do not extend to an action by the Australian Government or an Australian Government agency.

The EPBCA also replaces updates and strengthens the *Whale Protection Act 1980*, establishing the Australian Whale Sanctuary. This sanctuary covers Australia's entire EEZ, including that around Macquarie Island, and provides strict protection for all cetaceans (whales, dolphins and porpoises).

The EPBCA requires that all Australian Government-managed fisheries and all fisheries with an export component be assessed under the provision of Parts 10 (strategic assessment), 13 (protected species interaction) and 13A (wildlife trade) of the Act. Assessment is undertaken to determine the extent to which the fishery is managed in an ecologically sustainable way. The Macquarie Island fishery that operates adjacent to the reserve is currently under assessment.

The provisions of the federal *Historic Shipwrecks Act 1976* are applicable to all wrecks older than 75 years lying in State waters. The Act is concerned with sites lying below the low-water mark but is also applicable to all identifiable artefact material originating from these shipwrecks. It is an offence to engage in conduct which destroys, damages or causes interference with a historic shipwreck or historic relic unless that conduct is in accordance with a permit granted pursuant to that Act.

The federal *Quarantine Act 1908* restricts the import of human, plant and animal samples, and waste material into Australia, including Macquarie Island Nature Reserve.

State Legislation

The Resource Management and Planning System (RMPS) is an integrated system of policies and procedures which is given legislative effect. The objectives of the RMPS are:

- to promote the sustainable development of natural and physical resources and the maintenance of ecological processes and genetic diversity;

- to encourage public involvement in planning;
- to facilitate the state's economic development; and
- to promote the sharing of responsibility between the community, state government and local government.

The relevant laws that ensure sustainable development are the *Land Use Planning and Approvals Act 199*3, the *State Policies and Projects Act 1993, Environmental Management and Pollution Control Act 199*4 and the *Living Marine Resources Management Act 1995*.

In December 2002, the *National Parks and Wildlife Act 1970* was repealed and replaced by the *Nature Conservation Act 2002* (NCA) and the *National Parks and Reserves Management Act 2002* (NPRMA). The NCA provides for the reservation of land for conservation purposes. The NPRMA and the National Parks and Reserved Land Regulations 1999 provide for the management of that land, particularly through the preparation of management plans.

Seabirds and seals are protected under the *Nature Conservation Act 2002* and the Wildlife Regulations 1999, and cetaceans are protected under the *Whales Protection Act 1988*. Other marine animals and marine plants are managed under the *Living Marine Resources Management Act 1995*. Threatened species of flora and fauna are protected under the Tasmanian *Threatened Species Protection Act 1995*.

Historic cultural sites are protected under the Tasmanian *Historic Cultural Heritage Act 1995*.

A list of all relevant legislation is provided in Appendix 2.

3 Description of the Reserve

3.1 Climate

Macquarie Island's climate is cool, wet and windy, and extremely uniform due to the moderating influence of the surrounding ocean. Mean air temperatures vary from 3.3°C in winter to 7.0°C in summer. Sea surface temperatures are always within the range of the maximum and minimum air temperatures at the time. The mean wind flow over the island is north-west to westerly. Gale-force storms can occur, such as the one on 1 June 2003, with winds up to 92 knots (170 km/h). This particular storm washed away large areas of beach on the Isthmus and damaged station buildings as well as causing the relocation of historic cultural heritage artefacts.

Mean annual precipitation is 920 mm over 312 days of the year and average humidity is 89% (Copson & Whinam 2001). Precipitation occurs as mist, rain, hail, sleet or snow at all times of the year. Fogs are frequent, especially in winter. Due to almost constant cloud cover, light levels in the region are generally low, with a mean annual average of 2.2 hours of sunshine per day. Day length shows the most marked seasonal variation of all the climatic parameters, ranging from 17 hours in summer to 7 hours in winter.

Temperatures have been warmer and precipitation has decreased over the last few years. While a decrease in precipitation would have impacts, a change in the diurnal pattern of rainfall would have more impact. Heavier downpours of rain would cause erosion and flooding of nesting burrows. The increase in mean surface air temperature at Macquarie Island since 1949 is calculated to be 0.3°C degrees (Tweedie & Bergstrom 2000). This increase in the mean annual surface air temperature may have significant effects on biological systems if the trend continues (Bergstrom & Chown 1999).

The location of Macquarie Island makes it important for measuring global temperature changes. It forms one of a chain of meteorological stations in this sector from Antarctica to the subtropics. The meteorological observations at Macquarie Island are carried out at the station on the Isthmus (altitude 6 m). Observations were carried out during the Australian Antarctic Expedition (AAE) (1911–13), and by the Australian Bureau of Meteorology from 1913 to 1915 and from 1948 to the present day. The station is also used by the World Meteorological Organisation as a ground-truthing station for satellite weather data.

3.2 Oceanography

Unless otherwise attributed, the material presented in the next three sections is taken from Scott (1994) and Robinson and Scott (1999).

Regionally, the underwater topography is dominated by Macquarie Ridge and its associated trenches, and the Campbell Plateau to the east. Macquarie Ridge is consistently shallow, often less than 1000 m, although it only rises above sea level at Macquarie Island and its islets. The ridge is not continuous, and is cut in several places by

deep passes. The Macquarie Trench is located to the east of the ridge and is a continuous deep trench for a length of 480 km, with an average depth of 4700 m and a maximum depth of around 5500 m. Local and regional bathymetry is shown on Map 5.

East of the Macquarie Ridge complex and north of the Macquarie Trench, the Solander Trough separates the ridge from the Campbell Plateau. The plateau is an extensive area of relatively shallow water and is part of the continental shelf extending south-east from New Zealand. Depths are generally less than 1000 m. To the east of the Macquarie Trench, the Emerald Basin lies between it and the south-western end of the Campbell Plateau. To the west of Macquarie Ridge is a large, featureless basin.

Around Macquarie Island itself, the ridge slopes relatively gently to the west down towards the level of the ocean basin, which varies between around 2200 and 2400 m in depth. To the east, the gradient is much steeper and drops down fairly quickly into the Macquarie Trench, over 5000 m deep. To the north and south of the island, a narrow area of shallow water to 100 m depth extends along the ridge. As a result of its tectonic origin there is little or no shelf area around Macquarie Island. The 'shelf' is defined here by the 200 m isobath, as a noticeably sharp drop is indicated beyond about 100–200 m depth around the island and along the ridge.

Ocean circulation

The Southern Ocean is defined as the circumpolar ring of ocean surrounding Antarctica and extending northwards to the coastal waters of South America, Africa and Australia. It can be divided into three main hydrographic regions, separated by oceanic fronts where changes in temperature, salinity and other properties occur. The circumpolar scattering of subantarctic islands occurs either just to the south or just to the north of one of these fronts, the Antarctic Polar Frontal Zone (APFZ; formerly known as the Antarctic Convergence), with Macquarie Island located just to the north of it. Rather than a defined line, the APFZ is more like a series of large eddies, typically 70–80 km across, with twists and loops extending as far as 150 km north and south across four degrees of latitude. As a zone, its location is generally constant, although climatic conditions can cause it to vary its mean position within the zone by up to 100 km.

The APFZ is a distinct hydrographic boundary, although contrary to popular belief it is not itself a nutrient-rich zone, as it is an area of downwelling rather than upwelling. The cold surface waters to the south are more nutrient-rich than to the north, and a number of animal and plant species occur more on one side than the other. Local areas of higher productivity may occur within the APFZ however, as a result of eddying and turbulence.

Southern Ocean circulation is strongly influenced by the westerly surface winds or West Wind Drift, which results in an overall easterly movement of water. This movement is strongest in the central to northern area of the ocean, extending north of the APFZ, and results in the Antarctic Circumpolar Current, which has its main axis at about 50°S. Macquarie Ridge and Campbell Plateau form one of the main obstructions to the circumpolar movement of this current. Along with the proximity of the APFZ this appears to have a major influence on water circulation (and probably biological productivity) around Macquarie Island. The area is characterised by a high degree of turbulence and current variability, especially east of the ridge.

As the Antarctic Circumpolar Current approaches Macquarie Ridge, it is deflected south and passes around the tip of the ridge, then makes a sharp northward loop into the Emerald Basin. Parts of the current also flow through two deep passages in the ridge north and south of the island and meet up with the main current in the Emerald Basin. The recombined current then flows strongly along the south slopes of the Campbell Plateau. The main effect of this deflection is that warm water is forced 10° further south than usual. Because this warm water curves around the tip of the ridge, it results in a fairly permanent 'double front' in the APFZ, which is likely to increase the area of general turbulence and mixing south of Macquarie Island. The deflection is also likely to increase turbulence and eddying in the seas to the east of Macquarie Island where part of the current flows through the breaks in the ridge. The turbulence is likely to either directly or indirectly encourage biological productivity. The extent of upwelling around Macquarie Ridge itself is unknown, although presumably it must occur locally as minor portions of the current pass over the shallow areas of the ridge. This may also increase productivity in the area.

3.3 Marine Environment

All the seals and penguins and the majority of other seabirds breeding in the reserve derive all their food directly from the sea. The living resources of Macquarie Island are interdependent elements within the fabric of the marine ecosystem (Scott 1994).

Intertidal zone

In the intertidal area (i.e. high-water mark to low-water mark) six ecological zones can be recognised, extending from the high-water spring-tide level to below low-water mark.

The highest zone is dominated by lichens. Several mosses, vascular plants and algae also occur, and a number of small invertebrates live amongst the plants including mites, beetles, collembolans and amphipods.

Seawards from the lichen zone and forming the upper limit of high-water spring tides is the *Porphyra* zone, dominated by the red alga *Porphyra columbina*. Other species of red and green algae also occur here, and invertebrate fauna sheltering amongst the algae include mites, oligochaete and polychaete worms, bivalves, limpets and amphipods.

The third zone is the 'bare' zone, where the algae exhibit a closely grazed appearance and the limpet *Kerguelenella lateralis* is the dominant organism. Faunal associations are similar to those in the *Porphyra* zone. Limpets predominate, however, and the general absence of algae is probably due to this. The fourth zone is the upper red algal zone, dominated by dense growths of red algae. Fauna sheltering beneath the algae include amphipods, isopods, limpets, snails and worms, and include some species from the subtidal areas.

The fifth zone is the kelp zone, or lower intertidal area in the zone of maximum wave action, dominated by the giant Antarctic kelp *Durvillaea antarctica*. The kelp plays an important role in modifying the effects of wave action around the coast and minimising coastal erosion. Areas of rock among the kelp holdfasts are covered with coralline red algae, and the holdfasts, especially when eroded, support a variety of small animals.

The sixth zone is the subtidal lower red algal zone, dominated by coralline and other red algae and with a varied and extensive fauna.

Benthic algae

The benthic macro-algae of Macquarie Island are relatively well known to subtidal depths of around 20 m, but below 20 m depth there is little or no information. The rocky intertidal and subtidal areas of the Macquarie Island coast support extensive and luxuriant growths of seaweeds. The most immediately obvious plants are several species of large brown algae, especially the giant Antarctic kelp, covering intertidal rocks and growing in offshore beds. These supply shade for low-light tolerant red algae, reduce water movement below their canopies, and provide substrate for epiphytic algae. A total of 103 species of marine benthic macro-algae have been reported from the island, which is over twice the number of terrestrial plant species. Species diversity is far greater than that reported from any other comparable subantarctic island, although this is likely to reflect collecting intensity rather than anything unusual about Macquarie Island. Red algae are the most diverse, with 60 species, although the brown algae, with 28 species, dominate both the intertidal and subtidal zones. Green algae are the least diverse with 15 species.

Marine invertebrate fauna

Features characteristic of benthic invertebrates in subantarctic regions include high levels of endemism, high density and longevity, slow growth rates and high species diversity. Another feature is the relative absence of pelagic larval stages in the life cycle, unlike benthos of most other oceans. Instead, the majority of species brood their young, which may explain why groups which normally reproduce this way, such as amphipods and isopods, are abundant while benthic crustaceans which are often dominant elsewhere, such as crabs, shrimps and barnacles, are poorly represented. The reasons for this lack of a pelagic stage are not fully understood.

A number of collections and studies have been made of marine benthic fauna around Macquarie Island; however, the samples are still being analysed, and knowledge about the benthic fauna is still very incomplete. In shallow water areas to 20 m depths and below, rock faces below the kelp zone in sheltered and overhanging sites are covered with red algae and an encrusting fauna of sponges, hydroids, bryozoans, colonial sea squirts and associated polychaete/crustacean fauna. Various large mobile invertebrates also occur here, including starfish, sea cucumbers, sea urchins and molluscs. Both brown and red algae provide substrate and shelter for many of the smaller invertebrates.

On rock platforms investigated on the east coast, rock pools near the seaward edge contain red algae and a variety of invertebrates including polychaete worms, sponges, anemones and sea cucumbers. The sea floor in sheltered inlets provides various habitats for a wide variety of benthic fauna. Where the coast is subject to strong wave action, rocky channels and sand/gravel patches on the sea floor do not appear to support many invertebrates, although amphipods are common under boulders. At 15–20 m depths brown algae commonly form large beds among the boulders and sand patches, and their holdfasts accumulate sediment which also provides habitat for numerous small invertebrates. Amphipods are particularly abundant, both in actual numbers and numbers of species.

Results from dredges and hauls indicate that molluscs may be the dominant benthic invertebrates further offshore. They are the best documented group so far, although identifications are still not complete. Seventy-four species of bivalves, gastropods and chitons have been identified for both Macquarie Island and Macquarie Ridge. There appears to be a substantial degree of endemism in the species identified so far. Migration of mollusc fauna, echinoderms and presumably various other families, probably occurs more frequently south along the shallow tops of Macquarie Ridge than via the West Wind Drift from the Kerguelen Plateau to the west (e.g. associated with drifting kelp). However, the West Wind Drift is likely to be an important means of arrival for some benthic organisms, especially species like amphipods which live in and around macro-algae. The general lack of a pelagic stage in the reproductive cycles of many benthic animals in the region means that dispersal by the West Wind Drift through other means, such as the plankton, will be uncommon.

Fish

Within the Southern Ocean the majority of benthic fish are found on the Antarctic continental shelf or the shelf areas around islands, and are dominated by nototheniids (Antarctic cods). The open ocean is the realm of pelagic fish, mainly mesopelagic species inhabiting depths below about 200 m. The most widely distributed and abundant are myctophids (lanternfish).

The fish fauna of Macquarie Island is not well known compared to other subantarctic islands. A total of 12 species of benthic fish and 21 pelagic fish have been recorded so far. The shelf area around Macquarie Island is extremely limited. In terms of benthic fish, Macquarie Island Nature Reserve provides a small isolated area of shallow water in the transition zone between Antarctic and subantarctic waters. The island has a small number of benthic species compared to other subantarctic islands with larger shelf areas such as Iles Kerguelen with 42 benthic species, and South Georgia with 33 species. The benthic fish at Macquarie Island are dominated by the nototheniids, and three of the four most abundant species around the island are from this family.

The pelagic fish fauna around Macquarie Island is dominated by myctophids, small shoaling mesopelagic fish. Twelve of the 21 pelagic species around the island are from this family. Myctophids are widely distributed in the world's oceans, and in the Southern Ocean they are believed to comprise the second largest (after Antarctic krill) and most widespread biological resource. Four species, all with circumpolar distributions, contribute over 80% of the myctophid biomass in Antarctic and subantarctic waters, and these include the two species eaten most frequently by Macquarie Island penguins. Myctophids form a major part of the diet of all four penguin species and fur seals, indicating the availability of large numbers close to the island.

Patagonian toothfish (*Dissostichus eleginoides*) live in subantarctic waters on shelves, around islands and submarine banks. They are found at depths of between 300 m and 2500 m and can grow to over 2 m in length and up to 120 kg in weight. The oldest recorded toothfish to date was about 45 years old. They are eaten by sperm whales and elephant seals (NOO 2002), but not near Macquarie Island. Only a small proportion of the southern elephant seal diet is toothfish.

Fishing activity in the Macquarie Island region has the potential to impact on biodiversity through the removal of large quantities of target species and bycatch. A strategic assessment of the Macquarie Island Fishery is currently under way under the requirements of the EPBCA.

Squid

Squid are generally acknowledged to be abundant and important pelagic animals in Southern Ocean food webs, but very little is known about their distribution or ecology. A much greater species diversity and richness seems to occur in areas north of the APFZ and around it, rather than in the seasonal pack-ice region to the south. It is believed that there are two main trophic groups of squid in the Southern Ocean: those feeding in the euphotic zone chiefly on zooplankton, and those in the mesopelagic zone or deeper which feed on fish, squid and other organisms. Presumably the squid follow the diurnal vertical migration of the zooplankton. Squid around the APFZ area near Macquarie Island feed primarily on myctophid fish (Phillips et al., 2001).

The only information about squid around Macquarie Island comes from identification of squid beaks in diet samples of seabirds and seals, and the occasional mass strandings of cetaceans. Squid are relatively unimportant in the diets of the four breeding penguin species on Macquarie Island apart from gentoo penguins. Only two species were recorded, being taken by all four penguins. Squid are known to form a major part of the diet of albatrosses. In one study, 18 squid species were identified in the nests and stomachs of albatrosses breeding on Macquarie Island during the 1970s (van den Hoff 2001). A total of 19 cephalopods were identified in stomach samples from elephant seals at Macquarie Island. The known digestion rates of elephant seals suggest that these squid were probably caught within about four hours swimming time of the island, i.e. somewhere in or north of the APFZ. Squid may also be a primary food source for beaked whales and sperm whales in the Macquarie Island region.

3.4 Coastal Environment

The Macquarie Island coastline is rugged and predominantly rocky with small shingle and sand beaches, and is bounded on all sides by steep coastal slopes, with or without a strip of coastal terrace between the slope and the beach or rock platform. Coves and inlets, although uncommon, occur on both sides of the island. Several small islands, little more than groups of rock stacks, lie to the north and south.

The eastern coastline is reasonably straight with very few bays. There is little if any coastal terrace between the steep slopes and the shore. Rock platforms and stacks are common, although platforms are not as extensive as on the west coast, and sand and shingle beaches are more frequent than on the western side. Although more sheltered than the west coast, the east coast is still subject to severe storms which bring strong winds and high seas.

The western coastline has numerous indented bays along the length of the coast, and a raised marine terrace with relict seastacks. The coastal terrace is especially prominent along the northern half of the west coast, reaching up to 1 km wide at Handspike Point. The west coast shoreline itself is characterised by extensive reef platforms, sometimes

with narrow shingle beaches inland, and numerous seastacks and rocky points projecting between the bays. Winter storms come mainly from the west and southwest, and can bring huge seas.

The tidal range for Macquarie Island varies around one metre. Sea surface temperatures vary between a minimum of 3.28˚C in winter and a maximum of 7.28˚C in summer. This is too warm for sea ice to form around the island, and drifting icebergs are rare. Freshwater inputs from the land and associated turbidity are negligible around Macquarie Island. Mean wave height on the west coast is approximately one metre, and approximately 0.6 m on the east coast. Wave heights and water turbulence are greater on both coasts during winter.

3.5 Area and Topography

The terrestrial component of Macquarie Island Nature Reserve is approximately 12,785 hectares of the reserve's total area of 87,500 hectares (see Map 4). The main island is 34 km long by 5.5 km wide at its broadest point, the main axis being 15˚–195˚. A small group of islands, Judge and Clerk Islets, lies about 11 km to the north and the Bishop and Clerk Islets lie approximately 37 km south of the main island. There are also numerous sea stacks and reefs close to the island. Map 6 provides the topography of the island. It has steep coastal slopes, rising to an undulating plateau between 200 m and 300 m above sea level. Two peaks, Mt Hamilton and Mt Fletcher, are over 400 m. The Isthmus joins the main mass of the island to Wireless Hill at the north. There is a prominent raised beach terrace, up to 0.75 km broad, along the north-western third of the coast and a smaller one on the south-eastern third of the coast. There are many small lakes and pools on the plateau and raised beach terrace.

3.6 Geodiversity

Macquarie Island is an exceptional geological feature of world importance. It was listed as a World Heritage site in 1997 because of its geoconservation significance. Geologically it is totally oceanic in origin, all rock units having formed on or beneath the ocean floor. Unless otherwise attributed, much of the following description is taken from *Macquarie Island – A New Arrival. the Geological Development of a Young Island* (PWS 1999a).

Macquarie Island is the only exposed section of a vast undersea ridge that resulted from the contact between two major oceanic plates. It rises above a marine plain that is 2.5 km below sea level. The ridge extends to New Zealand, 1200 km to the north. Part of the structure is evident as the Alpine Fault that runs through the Southern Alps on the South Island. Associated with the Macquarie Ridge are three deep trenches, the Hjort, Puyseger and Macquarie Trenches, which reach about 5 km in depth.

Between 30 million and 11 million years ago Macquarie Island started life in the Southern Ocean as a spreading ridge, a small version of the mid-oceanic ridges which run for thousands of kilometres along the floor of the large ocean basins. Basalt lava, derived from deep within the Earth, flowed up to the ocean floor and out through long fissures or

volcanic vents forming new oceanic crust. The southern three-quarters of Macquarie Island are composed of basalt that has developed in these situations. It includes spectacular examples of pillow lavas including elongated pillows on a hill (which may be an old seamount), tabular basalt flows and small picrite plugs (Goscombe & Everhard 1998). In between the pillows, sedimentary abyssal oozes typical of ocean floor deposition at depths of between 2000 and 4000 m occur (Varne et al. 1969) and are thought to be of late Miocene age of 15 million years old (Quilty pers. comms.).

About 10 million years ago the spreading stopped. Instead of moving apart, areas on either side started to squeeze together. This major reversal in geological processes started forcing the embryonic Macquarie Island upwards - on its 2.5 km journey to finally emerge above the sea. Rock outcrops on the northern part of the island have been pushed up from about 6 km below the ocean floor, producing a unique exposure of rocks from the upper mantle (Varne & Rubenach 1973; Griffith & Varne 1980; Goscombe & Everard 1998). No drill hole has ever penetrated these depths and these exposures provide a rare opportunity for geologists to gain an understanding of rocks from the uppermost mantle (see Map 7). They include a classical section through an ophiolite sequence, from basalts at the top representing sea floor rocks, through a sheeted dolerite complex into massive and layered gabbros and finally a mixed zone of peridotite (Department of Environment, Sport and Territories 1996).

In the last 600,000 to 700,000 years, Macquarie Island has emerged above sea level and recent estimates suggests that, since about 6,000 years ago, it has been rising at an average rate of close to 1 mm per year (Adamson et al. 1996). Numerous palaeoshoreline features including old beach deposits or areas eroded by waves at altitudes ranging from 6 m to 400 m provide evidence for marine erosion that has occurred as the island has risen above the waves.

Glaciation was thought by early geologists around Mawson's time to be the dominant landforming process. They thought that ice may even have drifted from an adjacent continent to the west and scoured the top off the island. Up until the early 1980s there was still support for the idea that ice was the dominant landforming process. Evidence from palaeoshorelines including marine erosion and deposition has discounted widespread glaciation (Ledingham & Peterson 1984, Adamson et al. 1988).

The other major influence on the shape of Macquarie Island has been the extensive tectonic (including faulting) history (Frolich et al. submitted), which has resulted in intense earthquake activity. There are many large and active faults which have shaped the coast, created fault-dammed lakes and controlled the location of major landforms (see Map 7). Earthquakes trigger major landslip events, the scars of which cover many slopes. It is estimated that an earthquake of magnitude 7.5 on the Richter scale shakes the island every decade. The saturated peats on steeper slopes often slip during these events.

Wind and periglacial activity are major contributors to vegetation stripes and terraces that form in exposed locations. The wind damages and prunes plants and erodes fine material from gravelled areas on the windward sides of these features. This material as well as the loose gravel is then moved downslope by almost continuous precipitation, wind and periglacial activity. On leeward slopes, the risers (sloping parts) are generally vegetated while the treads (flat parts) are gravelled. It has been proposed that they form as a result of the base of the riser being eroded by frost heave, wind and water while vegetation grows over the lip of the tread. Terraces also occur on windward slopes; however, in

these situations the riser is gravelled whilst the tread is vegetation. In a few locations, terraces are fully vegetated. Rarely, they also exist as completely unvegetated forms.

Lowland peat bogs may be as deep as 6 m and are thought to have formed over the last 5000 to 10,000 years (Rich 1996; Selkirk et al. 1990). Excellent examples, known as 'featherbeds', occur at Handspike Point. This would suggest a very fast rate of organic accumulation or slow rate of decomposition in comparison to peats in other parts of the world. Rates are never constant (Selkirk-Bell 2000), but on average it appears as if the lowland bogs on Macquarie have developed at about 10 times the rate of many other peatland areas in the world. This may be because of peculiar nutrient conditions but is more likely to be a result of slow rates of decomposition.

Macquarie Island is an unusual feature for a number of reasons. No other island in the world has been squeezed upwards from the oceanic crust to form this kind of island. Most subantarctic islands initially developed as underwater volcanoes that are now exposed above the sea as a result of the accumulation of layers of lava (Department of Environment, Sport and Territories 1996).

As the geological origin of the island differs from that of other subantarctic islands, so does its landscape and the processes shaping it. Marine erosion processes such as wave erosion have moulded most of the Macquarie Island landscape as it has risen above sea level (Adamson et al. 1995). In contrast, most volcanic islands tend to develop in major explosive events when growth above sea level is very rapid and the only erosive effects occur around the coastal perimeter. Most other subantarctic islands have been eroded by ice action.

3.7 Natural Landscape

One of the two natural criteria for which Macquarie Island Nature Reserve was inscribed on the World Heritage List in 1997 was that it contains superlative phenomena or areas of exceptional natural beauty and aesthetic importance.

Around the shoreline there is a coastal terrace formed from a wave-cut platform now raised above sea level. Vast waterlogged areas on the coastal platform are dominated by mosses and lichens, forming deep peat beds and known locally as 'featherbeds', from the sensation experienced when walking over them. Old sea stacks testify to the continual uplifting of the island as they protrude through the peat beds, some of them now being several hundred metres from the existing coastline.

Behind the coastal terrace, steep escarpments rise more than 200 metres to the undulating central plateau that has two peaks over 400 metres, Mt Hamilton and Mt Fletcher. The plateau scarps are most spectacular at the southern end of the island and along the west coast where relentless pounding by the Southern Ocean has cut a myriad of rugged bays and coves, fringed with sea stacks and reefs.

The plateau surface is dotted with innumerable lakes, tarns and pools, many structural or fault-bound in origin (see Maps 6 and 7). Fluctuations in sea level and marine erosion have cut away the original escarpments leaving some lakes now perched on the edge of the plateau, while others have been partially or totally drained. The continual westerly

winds, which increase in force as they rise over the barrier of the island, and changes in the topography on the plateau result in dramatic changes in the vegetation cover.

Among the most aesthetically appealing sights of the island are the vast congregations of wildlife, particularly penguins, on suitable parts of the coastal terrace, especially during breeding seasons. The breeding population of royal penguins on Macquarie Island is estimated at over 850,000 pairs – one of the greatest concentrations of sea birds in the world. Four species of albatross nest on steep and rugged cliffs, both on the main island and on nearby Bishop and Clerk Islands. Elephant seals also form impressive colonies during the breeding season on suitable beaches.

3.8 Limnology and Water Quality

There are several large lakes on the plateau region of Macquarie Island, the largest being Major Lake (46 hectares). The combined total area of the lakes is over 200 hectares. Numerous smaller lakes and pools are found on the plateau and the raised beach terrace.

Work carried out by Tyler (1972), Buckney & Tyler (1974), and Mallis (1985, 1988) showed that the chemistry of the lakes and pools is greatly influenced by sea spray borne on the prevailing westerly winds and deposited with the precipitation. The cationic dominance in most cases is the same as for sea water and salinities decrease across the island from west to east. The major exceptions to this pattern are Square Lake and Waterfall Lake, which have as yet unexplained higher concentrations of calcium. A few pools and lagoons are so close to the sea that seaweeds are washed into them during storms. Croome (1984) noted that most of the water bodies of the island were clear and oligotrophic, with few species. The effect of seasonal nutrient inputs (some of massive proportions) from penguin colonies into several streams and a few pools is unknown.

Fresh water is supplied to the station for human use from the plateau via Gadgets Gully.

3.9 Vegetation

The isolation of Macquarie Island from other land masses has meant that all native plants have established by long-distance, over-ocean dispersal after being carried there by wind, birds or water (Bergstrom & Selkirk 1987), except for endemic species that may have evolved on the island. The prevailing climate means that neither trees nor shrubs presently occur on the island. Grazing, burrowing, trampling and manuring by native or introduced animals have all affected plant growth.

The diversity of the terrestrial vegetation of Macquarie Island, like all subantarctic islands, is limited largely by its geographical isolation, small size, relatively small areas suitable for colonisation, and low temperatures of the summer growing season (Selkirk et al. 1990). The vascular flora of Macquarie Island consists of 46 species (Hnatiuk 1993), which include three endemic species: the cushion plant *Azorella macquariensis,* the orchid *Nematoceras dienema* and the coastal grass *Puccinellia macquariensis,* and five alien species, two of which have been recently eradicated (Copson & Whinam 2001). One plant species, *Crassula moschata,* listed as rare in Tasmania under the Tasmanian

Threatened Species Protection Act 1995, is common on Macquarie Island. Macquarie Island is the most southerly location recorded for naturally occurring orchids. The flora of Macquarie Island is listed in Appendix 3.

Subantarctic island vegetation communities are recognised globally for monostands of megaherbs. Two such species, *Stilbocarpa polaris* and *Pleurophyllum hookeri*, exhibit their maximum expression within their very restricted global distribution on Macquarie Island, with spectacular vegetative and floral displays.

There are no known endemic moss or liverwort species and lichen taxonomy is still too uncertain to indicate endemic taxa (Seppelt pers. comm.). Some 81 species of mosses, over 50 hepatics and over 150 lichens make up the terrestrial non-vascular flora (Seppelt pers. comm.) and 127 species of freshwater and terrestrial algae recorded (Kantvilas & Seppelt 1992). More than 200 macro-fungal species are now known to occur (Laursen et al. unpublished data).

The Antarctic kelp (*Durvillaea antarctica*) plays a dominant role in the shore ecology of Macquarie Island. It not only provides habitats for large numbers of invertebrate species and some fish, but also tempers the effects of the surf breaking along the shore, providing shelter for more delicate species. Coralline and other red algae also form a conspicuous band in some areas. Large quantities of seaweeds may be deposited high up on the beaches during storms, providing food for many species of invertebrates, such as kelp flies. One hundred and three species of marine algae have been recorded (Selkirk et al. 1990). The importance of the surrounding marine biota to many fauna species in the reserve cannot be over-emphasised.

The major vegetation formations on the island are tall tussock grassland (including fernbrake), short grassland, herbfield, mire (incorporating Taylor's 1955 fen and bog), fernbrake and feldmark (Selkirk et al. 1990).

Tall tussock grassland is dominated by *Poa foliosa* tussocks, *Stilbocarpa polaris* and locally by *Polystichum vestitum*. It occurs on the better-drained sections of the coastal terraces, most of the steep coastal slopes, and in sheltered, well-drained valleys. Small burrowing birds, such as petrels and prions, nest in the tussock areas because they provide cover from predators such as skuas. Tall tussock is the principal habitat for rats on the island. In the past, heavy grazing by rabbits destroyed some tall tussock grassland areas (Copson 1984, Scott 1988), converting them to short grassland or mire. Rabbit control measures (see Section 5.9) allowed the tall tussock grassland to regenerate in some areas (Copson & Whinam 1998). However, in the last few years rabbits appear to have greatly increased in localised areas due to a combination of factors: cat eradication, climate change and possible attenuation of *myxoma* virus effectiveness. There is severe damage to vegetation due to rabbit grazing in these areas, particularly on the southern slopes of the island.

Short grassland occurs extensively on sheltered upland areas and is dominated by species of *Agrostis magellanica, Luzula crinita, Uncinia spp., Deschampsia chapmanii* and *Festuca contracta*. This is a major habitat for rabbits on Macquarie Island and has therefore been greatly modified in some areas. Short grassland covers areas of the raised beach terraces and the plateau that have a moderate-to-high water table and/or wind exposure (Taylor 1955).

Herbfields are dominated by *Pleurophyllum hookeri* and/or *Stilbocarpa polaris* with *Blechnum penna-marina* and *Acaena magellanica*. Herbfields occur on sheltered slopes, flats and valleys to a maximum altitude of 380 metres in sheltered valleys, and on raised coastal terraces. This is a habitat also favoured by rabbits. Where these species have been badly damaged by selective grazing, rabbits would have to be eradicated for their recovery to occur (Copson & Whinam 1998).

Mires incorporate bogs and fens, where the water table is at or near the surface. Mires usually occur on valley floors, on the plateau and in small patches on raised coastal terraces. Peat in this habitat may be up to 6 metres deep in places. The sedge *Juncus scheuchzerioides* is dominant, in association with *Ranunculus crassipes*, *Montia fontana*, *Cardamine corymbosa* and many bryophytes including *Sphagnum falcatulum* and *Breutelia pendula*. Of particular note are the extensive 'featherbeds' or quaking mires that occur on the coastal terrace at Handspike Point and Half Moon Bay (Rich 1996). These communities are dominated by bryophytes. The water in bogs tends to be acid and low in soluble salts, while the fens tend to have water that is neutral or alkaline.

Feldmark is the most widespread vegetation formation, covering approximately half of the island (Taylor 1955). It occupies the most wind-exposed areas of the plateau region and upland areas. Vegetation cover varies from over 50% in sheltered areas to less than 5% in exposed sites. The dominant species are the cushion-forming *Azorella macquariensis*, bryophytes such as *Ditrichum strictum* and *Racomitrium crispulum*, and lichens. Periglacial and wind effects are major contributors to the structure of feldmark vegetation (Selkirk et al. 1990).

Map 8 shows the distribution of structural vegetation formations on the island, mapped from satellite imagery (Selkirk & Adamson 1998). Vegetation categories based on foliage density and foliage height were mapped. Species could not be distinguished from the imagery. The structural vegetation categories can be related to the formations described above: closed tall herb vegetation includes tall tussock grassland; closed short herb vegetation includes short grassland and herbfield; open short herb vegetation includes feldmark.

3.10 Native Fauna

As a remote speck of land in the Southern Ocean, Macquarie Island and its adjacent seastacks, provide an essential breeding and moulting site for several species of seal and a number of seabirds. Map 9 shows the locations of the major seal, penguin and albatross breeding areas on Macquarie Island. Of the native mammals and birds breeding in the reserve today only the black duck *Anas superciliosa* and the kelp gull *Larus dominicanus* spend all of their life cycle on the island. The only two native terrestrial birds recorded from the island, the Macquarie Island rail *Rallus philippensis macquariensis* and the Macquarie Island parakeet *Cyanoramphus novaezelandiae erythrotis*, became extinct in the 19th century. By 1820 the native fur seal population (over 200,000 animals) had been exterminated by sealers (Cumpston 1968). The original species composition of fur seals on the island is unknown. It was over 130 years after the island began to be recolonised by fur seals before another fur seal pup was born, in 1954.

All native terrestrial invertebrates reached the island by long-distance dispersal either on the wind or hitching rides on birds. It is thought that a significant proportion of the Macquarie Island insect fauna came from sources to the west of the island rather than Australia or New Zealand.

Human impacts, commencing in the region just over 200 years ago and on Macquarie Island in 1810, have resulted in major changes to the biota of the reserve. The commercial exploitation of seals and penguins, together with the introduction of alien carnivores, herbivores and omnivores, resulted in the extinction of some native species and major declines in others. Resultant modifications to vegetation associations and nutrient cycles severely impacted on some species while benefiting others (Copson 1984, Copson & Whinam 2001).

Active management programs, commenced in the 1960s, are aimed at stopping and/or reversing some of these trends (see Sections 5.9 and 6.6). Some of these programs have resulted in very rapid changes. However, the restoration of natural ecosystem processes as a result of these management programs may take centuries (Frenot & Copson 1995).

3.10.1 Threatened Species

As of June 2003 there are 16 species of native fauna and one plant species that are listed in the Schedules of the Tasmanian *Threatened Species Protection Act 1995*. Five other fauna species are currently under review for inclusion (see Appendix 4). A total of 22 seabird species and 5 sea lion/seal species are considered threatened according to World Conservation Union (IUCN) criteria (NOO 2002).

3.10.2 Mammals

The native mammals within the reserve are all marine (Appendix 5). Three species of fur seal and Southern elephant seals breed on the island while two seal species are regular visitors and two are rare vagrants. Several species of whale and dolphin have been recorded around the island but only the killer whale *Orcinus orca* appears in any number (Copson 1994). No commercial whaling ventures were ever based on the island.

Seals

Fur seals were the initial focus of commercial exploitation and the native fur seal(s) (unknown) population, estimated at 200,000 animals, was exterminated within 10 years of the island being discovered (Cumpston 1968). Three species of fur seal now occur in mixed colonies in the reserve. Up to 1000 New Zealand fur seals *Arctocephalus forsteri* may be ashore in March, mainly immature males. Small numbers of subantarctic fur seals *A. tropicalis* and Antarctic fur seals *A. gazella* have been breeding on the island since the 1970s (Shaughnessy et al. 1988). It was thought that most hybridisation occurred between these two breeding species. However, recent genetic studies have shown that extensive hybridisation and backcrossing occurs among all three species and that there are very few pure subantarctic fur seals (only 7.5%) on Macquarie Island (M. Lancaster, pers. comm.). The endangered subantarctic fur seal's future in the reserve is unlikely to be sustainable unless significant levels of immigration into the Macquarie Island population of pure subantarctic fur seals occur soon. The conservation status of all three species of fur seal at Macquarie Island is changing rapidly. Isolation from other fur seal

populations, hybridisation and predation on pups by Hooker's sea lions are the major factors influencing the recovery of fur seals in the reserve.

Southern elephant seals *Mirounga leonina* have recovered rapidly from the exploitation of the 19th century and by the mid-1950s the population using the island was estimated at 155,000. Since the 1960s it has declined steadily at a rate of about 1.2% per annum, and the population is now approximately 40% of what it was in the 1950s. However, the rate of decrease has apparently slowed in recent years (Burton pers. comm.). In 1987 the population was estimated at around 90,000, with approximately 20,000 pups being born annually (Hindell & Burton, 1988). Current estimates (2003) are 70–80,000 for the total Macquarie Island population (Burton pers. comm.) Southern elephant seals use the island to rest, moult and breed. They usually return to the island twice a year as adults, once to breed and once to moult. Juveniles return once to moult and once for a mid-year rest. Extensive research through the 1990s has shown that the adult seals travel as far as the Antarctic continental shelf, feeding within the pack-ice edge during winter. They can submerge for periods of more than two hours and dive to over 1,700 metres. Elephant seals can grow to over 4.5 metres in length and to a weight of 3.5 tonnes. Conflicts between the larger bulls are among the more memorable sights on the island.

Hooker's sea lion *Phocarctos hookeri* and leopard seals *Hydrurga leptonyx* visit the island during winter and spring in small numbers. Weddell seals *Leptonychotes weddelli* and crabeater seals *Lobodon carcinophagus* are very rare vagrants from the south.

Whales and Dolphins

A list of whales and dolphins recorded within 12 nautical miles of and/or found stranded on the island is given in Appendix 5 (Goodall & Galeazzi 1985; Copson 1994). Killer whales are the most common species observed and have been recorded throughout the year, though are most often sighted during the peak breeding season of southern elephant seals (Morrice et al. 2002). Pods are usually small and, although they have been seen feeding on both penguins and seals, they do not appear to fully exploit this food source or to have developed specialised feeding methods as has been reported from other areas. The only other regular visitor is the longfin pilot whale *Globicephala melaene,* occasionally seen in small pods offshore.

3.10.3 Birds

More than 90 species of bird, including over 60 non-breeding or vagrant species, have been recorded at Macquarie Island. The breeding bird fauna comprises four penguins, four albatrosses, nine certain and four probable petrels, one cormorant, two ducks, one skua, one gull, one tern and two passerines (Appendix 6). One of the ducks and the two passerines are alien species that have become established in the reserve. Penguins are the most numerous birds breeding on the island at present.

King Penguins

The king penguin *Aptenodytes patagonicus* recovered rapidly from the slaughter of the last century (Rounsevell & Copson 1982). The breeding population, estimated at around 150,000–170,000 breeding pairs in 2000, is still expanding. It is estimated there are now between 400,000 and 500,000 king penguins in the reserve. Chicks from one season are

not fledged until the following spring so many adults revisit the reserve during the winter to feed chicks. Their main diet is composed of two species of myctophid (lantern) fish (Hindell 1988a). Both species commonly occur at depths to 150 metres.

Gentoo Penguins

In 2002 the breeding population of gentoo penguins *Pygoscelis papua* in the reserve was estimated at about 3,800 pairs (Robinson pers.comm.). They move nesting sites each year and, although very shy, they nest within the station boundaries at times. The species remains at the island all year round, feeding locally and usually returning ashore each day. Myctophid fish constitute most (59% by weight) of the diet of this penguin species (Hindell 1989).

Royal Penguins

The royal penguin *Eudyptes schlegeli* is endemic to Macquarie Island. The population has been estimated at approximately 850,000 breeding pairs in 57 colonies, with one colony at Hurd Point, containing approximately 165,000 breeding pairs (Copson & Rounsevell 1987). The adults leave the island in late April, returning in mid-September. Their diet is mainly krill and a species of myctophid fish, with other fish and squid being eaten in small amounts (Hindell 1988b). While raising chicks, adults follow currents several hundred kilometres to the southern edge of the Campbell Plateau, returning on counter currents.

Rockhopper Penguins

Rockhopper penguins *Eudyptes chrysocome* breed in medium to large colonies on the west and south coasts and in several small colonies on the east coast (Rounsevell & Brothers 1984). Due to the difficult terrain of the reserve, the size of the total population is very difficult to estimate but may be as high as 100,000 breeding pairs. The population status needs to be determined as a decline in rockhopper penguins of up to 80% has been recorded in other locations. There has been no evidence of such decline on Macquarie Island. In some areas there has been clear increases in colony size (Brothers pers. comm.). The penguins' diet consists mostly of krill but both pelagic and inshore fish species are also eaten occasionally.

Albatrosses

Wandering albatrosses *Diomedea exulans* breed in very low numbers on the island (Tomkins 1985; Gales 1993). In the mid-1960s there were about 50 breeding pairs but since 1980 less than 10 eggs have been laid each year (Gales & Terauds, pers. comm.). There are currently only 19 breeding pairs. These albatrosses are biennial breeders, taking about 12 months to rear a chick and, if successful, do not breed the following year. This breeding population is considered to be at risk, almost certainly due to their accidental bycatch by longline fisheries (Brothers 1991). Strict controls may be placed on human access to critical habitat for breeding birds by declaring Special Management Areas (see Section 6.2.4), such as the south-west corner of the reserve and the featherbed areas, when deemed necessary.

Grey-headed albatrosses *Thalassarche chrysostoma* breed only in the South West Point area of Macquarie Island. The estimated population in the reserve of this biennial breeding species is around 100–120 breeding pairs (Gales & Terauds, unpublished data).

In 2002 Macquarie Island was listed on the Register of Critical Habitat under the *Environment Protection and Biodiversity Conservation Act 1999 (*EPBCA) for the wandering albatross and the grey-headed albatross, both of which are listed under the Act as vulnerable to extinction. Macquarie Island is the only breeding habitat under Australian jurisdiction for these two species. Satellite tracking of grey-headed albatrosses shows that these birds undertake foraging trips of more than 1000 km during breeding season (Gales & Terauds, unpublished data).

Black-browed albatrosses *Thalassarche melanophrys* breed at only two sites in the reserve (Gales & Terauds 2000–2002 unpublished data), around South West Point (38–45 breeding pairs) and on Bishop and Clerk Islets, estimated at approximately 100 breeding pairs in 1993 (Copson 1988; Gales 1993). Black-browed albatrosses feed close inshore, but also feed hundreds of kilometres offshore during the breeding season.

The most numerous of the albatrosses breeding in the reserve is the light-mantled sooty albatross *Phoebetria palpebrata*. It nests on steep, tussock-covered slopes all around Macquarie Island with a breeding population estimated at 1500–1800 pairs (Gales & Terauds 2000–2002 unpublished data). Satellite tracking of breeding birds indicates that some feed several hundred kilometres to the south-west of the island, around the Antarctic Polar Frontal Zone (Weimerskirch & Robertson 1994; Gales & Terauds unpublished data).

Giant Petrels

The southern giant petrel *Macronectes giganteus* and northern giant petrel *M. halli* are both fairly common, but there has also been an as yet unexplained decline of over 50% in both giant petrel populations in the past 20 years, in common with most other breeding sites around the world. Like albatross, it is likely that longline fishing methods have contributed to their decline. Current estimates for the southern giant petrel are 2300 breeding pairs and for the northern giant petrel 1200–1500 breeding pairs (Gales & Terauds 2000–2002 pers. comm.).

Other Petrels, Prions and Other Birds

Besides giant petrels, seven species of petrel breed in the reserve while four others may also do so (Appendix 6). Of these only two species breed in the reserve in large numbers, the Antarctic prion *Pachyptila desolata* (40,000 pairs) and the white-headed petrel *Pterodroma lessonii* (9000 pairs). The five other breeding petrel species all breed in low to very low numbers. It appears likely that soft-plumaged petrel *Pterodroma mollis* and, grey-backed storm petrel *Oceanites nereis* are breeding in the reserve, but this still needs to be confirmed (Brothers 1984, Brothers unpublished report 2000). Wilson's storm petrel *O. oceanicus* breeds on Bishop and Clerk Islets (Brothers pers. comm.).

It is thought that alterations to habitats by rabbits, and predation by skuas and introduced cats, wekas and rats, have greatly reduced or even eliminated populations of some of the smaller species of prion and petrel which once bred in the reserve (Brothers 1984;

Brothers & Copson 1988). A recent long-term study in the Crozet subantarctic isles showed that up to 41% of breeding failures in white-chinned petrels could be attributed to rat predation (Jouventin et al. 2003). Results from the vertebrate pest management program on Macquarie Island (see Section 5.9) are showing a reversal of these trends and some burrow-nesting species, such as grey petrels, are re-establishing on the island.

The breeding population of the endemic subspecies of the king shag *Phalacrocorax albiventer purpurascens* on Macquarie Island has been estimated at 660 pairs in 19 colonies around the island (Brothers 1985). The birds are not strong fliers which, together with a limited diving capacity and the steeply shelving sea bottom around the island, limits their feeding grounds to a restricted area close inshore.

Great skuas *Stercorarius skua lonnbergi* are common on Macquarie Island for nine months of the year but disperse out to sea over the early winter period. Studies carried out in 1974–75 indicated that the skua distribution was correlated to that of the rabbits, which provided an added food source (Jones & Skira 1979). Following the reduction in the rabbit population due to the rabbit control program, there was a decline in the number of skuas breeding on the plateau area in the early 1980s (Skira 1984). Surveys to determine whether skua numbers correlate with rabbit numbers should be continued, to provide baseline information for rabbit control and/or eradication programs.

Kelp gulls *Larus dominicanus* breed in low numbers around the coast and on offshore sea stacks. They are present all year round and flocks of up to 50 birds are often seen feeding in the mire regions along the coast and on the plateau.

The Antarctic tern *Sterna vittata bethunei* breeds in very small numbers on Macquarie Island. The first island-wide census since the late 1970s was conducted in late November 2003, locating only 24 breeding pairs in 13 colonies (Schulz & Gales in prep.). It is possible that alien predators such as feral cats, wekas and ship rats have greatly reduced its numbers on the main island (Garnett 1992).

The only native duck on Macquarie Island is the black duck *Anas superciliosa*, which occurs in small numbers. Recent work has shown that hybrids of black ducks and mallard *Anas platyrhynchos* are also resident in the reserve and it is possible that the native strain will ultimately disappear (Norman 1987).

No native passerines have ever been recorded at Macquarie Island.

3.10.4 Reptiles and Amphibians

No reptiles or amphibians have been recorded in the reserve.

3.10.5 Terrestrial Invertebrates

It has been estimated that there are less than 300 terrestrial invertebrate species on Macquarie Island (Greenslade 1990). Of these, approximately 10% are thought to be endemic, with a few others doubtfully so. Greenslade (1990) reports that the number (140) of terrestrial arthropod species known from the reserve is low compared to its two nearest neighbours, the Auckland Islands (453) and Campbell Island (354).

Although several collections of terrestrial invertebrate fauna have been made on Macquarie Island, most have been concentrated on the arthropods (Gressitt 1962, 1967). The majority of published studies have been taxonomic descriptions, although some ecological work has been carried out on a few individual species.

Fourteen species of nematodes (Bunt 1954) have been recorded, plus a further 12 undetermined species. Also recorded were a native land snail and three species of slug, two native and one cosmopolitan, the latter probably introduced by the sealers as it is a common European species and was first recorded on the island during the Australian Antarctic Expedition (AAE) (Selkirk et al. 1990). A study of the rotifers identified 39 species, several of which have also been found on South Georgia and/or Signy Island (Dartnall 1993). Many of the freshwater invertebrate species found on Macquarie Island have also been found at other subantarctic and Antarctic locations (Evans 1970; Dartnall 1993; Frey 1993).

No freshwater fishes have been recorded in the reserve.

3.11 Alien Species

Alien species are those that are considered to occur outside their normal or natural range, either as a direct or indirect result of human activity, or as self-introductions from a site of known human introduction. Special precautionary measures (inspecting, cleaning and/or fumigating supplies and equipment) are undertaken to reduce the possibility of alien introductions through human activities. Contracts for tourism operators visiting the island also stipulate precautions to be taken to prevent accidental introductions. The tourist visitation sites are monitored by Tasmanian Parks and Wildlife (PWS) staff for possible introductions. There is also a risk of introducing alien marine species in the Macquarie Island region from scientific support and tourist ships. Awareness and simple changes to operating procedures may reduce the risk of introductions in the future.

3.11.1 Alien Plant Species

Five alien plant species are recorded in the reserve, *Cerastium fontanum, Stellaria media, Anthoxanthum odoratum, Poa annua* and *Rumex crispus* (Taylor 1955; Copson & Leaman 1981; Seppelt et al. 1984). *Poa annua, Cerastium fontanum* and *Stellaria media* are common and widespread. *Anthoxanthum odoratum* and *Rumex crispus* occurred at single localities and have now been removed (Copson & Whinam 2001). The sites will need to be monitored for several years to know whether eradication was successful.

3.11.2 Alien Fauna

Over the years various domestic animals were taken to the island, including horses, donkeys, pigs, cattle, goats, dogs, cats and sheep, but none of these remains today. Cats *Felis catus* have recently been eradicated. Three alien mammal species are still present on the island: European rabbits *Oryctolagus cuniculus*, ship rats *Rattus rattus* and house mice *Mus musculus*. There is currently no evidence of any alien fauna species on Bishop and Clerk Islets or Judge and Clerk Islets.

Feral cats were recorded on Macquarie Island as early as 1820 (Debenham 1945). Studies carried out in recent years gave population estimations of 250–500 (Jones 1977), and 170–250 (Brothers et al.1985). Jones (1977) and Brothers (1985) estimated that about 60,000 birds each year were killed by feral cats. A cat eradication program began in 1985, with total eradication of cats declared successful in 2002 (Copson 2002); see Section 5.9).

European rabbits were released by sealers in the 1870s as an additional food source (Cumpston 1968). They are now found throughout the island. In 1978 the overwintering population was estimated at 150,000 rabbits (Copson et al. 1981). In December 1978 control measures were begun using myxomatosis (see Section 5.9). The estimated population in 2002 was 16,000 (Copson 2002).

The house mouse and ship rat both became established on the island early in the last century (Cumpston 1968). Both rats and mice are widespread; rats are particularly prevalent in the tall tussock vegetation and mice in herbfield and short grassland. Both rodents are omnivorous, and recent evidence suggests potential detrimental impacts on reproductive success of some plant species (Shaw et al. 2005). Brothers (1985) found evidence of ship rats destroying young petrels in their nesting burrows. Pye (1993, 2000) has studied the reproductive biologies of mice and rats on Macquarie Island and suggests that rat populations will expand due to cat eradication and will occupy new territories, thus reducing the availability of nesting sites for the smaller seabirds. Brothers (pers. comm.) does not agree that rats will necessarily reduce nest-site availability for smaller seabirds, but believes that effects of climate change and rabbit control may be greater determinants. The rugged topography of Macquarie Island, together with the rodents' widespread distribution, abundance and reproductive capability mean that eradication will be a considerable challenge (Pye 2000).

No native passerine bird species have been recorded from Macquarie Island. The redpoll *Acanthis flammea* and common starling *Sturnus vulgaris* are considered to be self-introduced aliens and are widespread on the island. Both became established in the reserve early in the 19th century after their introduction into New Zealand from Australia (Falla 1937; Copson 1995c).

In the 19th century mallards *Anas platyrhtynchos* were also introduced into New Zealand and Australia, from where they have spread naturally to other islands, including Macquarie Island (Copson 1995c).

Wekas *Gallirallus australis scotti* were introduced from New Zealand in the mid-1800s as a source of food for the sealers (Cumpston 1968). They probably contributed to the extinction of the endemic subspecies of land rail and parakeet (Taylor 1979). They were successfully eradicated in the 1980s (Copson 1995b).

Other bird species have been recorded in recent years but all appear to be vagrants.

3.11.3 Alien Invertebrates

Nine species of terrestrial invertebrates thought to have been introduced by human activities have been recorded, together with another six transient aliens that are not established residents (Greenslade 1990). The European rabbit flea *Spilopsyllus cuniculi* has been deliberately introduced onto Macquarie Island several times since 1968, to act as

a vector for the m*yxoma* virus used to control rabbits (Skira et al. 1983). The rabbit flea can only breed on rabbits so when the rabbits are eradicated from the reserve the fleas will also be eliminated.

A program to monitor windborne invertebrates ran for several years at Macquarie Island, providing data on the immigration of invertebrate species in the region. It also provided information useful in judging whether newly recorded species may have arrived by natural means or been introduced by human activities (see Section 6.6).

3.11.4 Alien Marine Flora and Fauna

Due to the remote location of Macquarie Island, little is known of the coastal communities and any alien introductions to the marine areas of the reserve. Further survey work is needed.

3.12 Historic Cultural Heritage Values

Macquarie Island is one of the earliest sites occupied by Europeans in Australia (see Section 1.4). The first European settlement in Tasmania, Risdon Cove, was established only seven years prior to the discovery of Macquarie Island. However, the occupation of the island was fundamentally different from the early settlements in Australia in that it was of a temporary nature and carried out by private enterprise, not government. In terms of the early economic/technological development of Australia the island is unique, the only comparable activities being those of the sealers in Bass Strait.

Commercial exploitation of the island's wildlife was carried out intermittently for 110 years. Sites of historical interest, including the remains of shipwrecks and shore facilities, are scattered around most of the coastline of Macquarie Island (see Map 4) and reflect changes in the technologies of Australia and New Zealand over this period. All sites have suffered over the years to a lesser or greater extent from natural causes and from human interference, both accidental and deliberate. Work by Townrow (1989) resulted in the identification and recording of pre-Australian Antarctic Research Expeditions (ANARE) period cultural resources. The Conservation Plan by Brown and Townrow (1989) detailed the significance of the pre-ANARE period historic cultural resources of Macquarie Island.

The research station on Macquarie Island is the oldest continually occupied ANARE station and one of the oldest in the Antarctic region. While none of the original buildings at the station survive, the two field huts remaining at Sandy Bay and Lusitania Bay are representative of the earliest ANARE occupation of the island. These huts have been in continual use until quite recently (1993 and 1996, respectively) and are representative of the history of ANARE research and field operations. They have particularly close associations for many people who have lived and worked at Macquarie Island. These huts and a number of the sealing sites also have considerable potential for educational and interpretive use (Nash 2003). Statements of significance for 11 of the historic sites in the reserve are provided in Appendix 7. These sites have been nominated for inclusion on the Tasmanian Historic Site Register under the Tasmanian *Historic Cultural Heritage Act 1995*. Section 5.10 provides policies and prescriptions for the management of the historic cultural heritage of the reserve.

3.13 Cultural Landscape

Cultural landscape values in the reserve are found in the remains of the historic sites scattered along the coastline of the reserve and on Wireless Hill. The cultural landscape of the station on the Isthmus is significant in that it has been operating continuously since 1948 and is the oldest continuously occupied station in the Australian Antarctic program. The overall appearance of the station from a distance (i.e. from a ship) has changed little over the years, compared to the changes that have occurred at other stations, particularly in the Antarctic. Certain areas of the station have more cultural landscape significance than others, due to historic buildings, remains and history of use (Vincent pers. comm.). Changes to the use and appearance of these precincts must take into account their historic, social and cultural significance. Sections 5.10, 6.3 and 6.12 provide policies and prescriptions for any future development of the station.

PART B - MANAGEMENT POLICIES AND PRESCRIPTIONS

The following sections of the plan provide the statutory objectives for management of the Macquarie Island Nature Reserve and the management policies and prescriptions necessary to give effect to those objectives. These bind the Director of National Parks and Wildlife as the managing authority under the *National Parks and Reserves Management Act 2002*.

In respect of the *Nature Conservation Act 2002*, the Director may enter into arrangements with the Secretary of the Department of Primary Industries and Water for the purposes of furthering the objectives of that Act in regard to conservation, and protection of fauna, flora and geological diversity of the state, the declaration of national parks and other reserved land and related purposes. These policies and prescriptions apply to the Macquarie Island Nature Reserve and the Macquarie Island World Heritage Area to the limit of state waters (see Map 3). The rest of the World Heritage Area, from 3 nm to 12 nm, is managed by the Department of Environment and Heritage on behalf of the Australian Government. The Macquarie Island Marine Park from 3 nm to 200 nm on the eastern side of the reserve is managed by the Department of Environment and Heritage.

While this plan does not bind the Australian Government, ss. 322 and 339 of the EPBCA require the Australian Government to take all reasonable steps to ensure that it exercises its powers and performs it functions in a way that is not inconsistent with this plan. The Australian Antarctic Division and the Bureau of Meteorology are the major Australian Government agencies currently operating in the reserve.

4 The Vision and Objectives for the Reserve

4.1 The Vision for the Future

Macquarie Island Nature Reserve and World Heritage Area is one of the most valued and valuable conservation properties in Australia and the world, and should be managed on this basis to ensure its values are sustained in perpetuity.

The Vision Statement – 50 years hence

Macquarie Island is a nature reserve where all of the World Heritage values, biosphere reserve values, National Estate values and state nature reserve values are protected and conserved. There is a relatively unaltered natural diversity, including geodiversity and biodiversity. The populations of some threatened species in the reserve appear to be recovering, even if their populations are still threatened elsewhere. Human visitation and use of the reserve is controlled and carefully managed to minimise adverse impacts on the reserve. Scientific research, monitoring and management programs continue with minimal and/or transitory impacts on the natural and historical values of the reserve. There have been no apparent further introductions of alien species. Rabbits, rats and mice have been eradicated. There is full awareness and appreciation of the special conservation value and character of the reserve by the international community, the Australian federal, state and local governments, scientists, tourists and the Australian public, to the extent that protection of the reserve is recognised to be of utmost importance.

In order to achieve this vision, the precautionary principle in management will apply. The eradication of rabbits and rodents is essential to the long-term conservation of the natural values of the reserve. Human impacts due to the conduct of scientific research, educational tourism or conservation management programs must be assessed in terms of risk and benefit, and must meet consistent environmental protection and quarantine standards. Off-reserve interpretation will continue to be developed to foster public appreciation. Educational tourism to the reserve must be controlled. Scientific programs that contribute to global understanding or that directly benefit ecosystem conservation and management will be encouraged where they show negligible, minor and transitory impacts on the natural and historical values of the reserve.

4.2 Key Desired Outcomes of This Plan

Based on the vision statement above, the following are the key desired outcomes resulting from successful implementation of this management plan over the next seven years, and into the foreseeable future. Key indicators will be developed from these to inform management of progress toward the achievement of these key desired outcomes. Some key indicators have been identified and are listed in Appendix 10.

- The World Heritage values of the reserve are identified, protected, conserved, managed and, where necessary, rehabilitated.
- Geoconservation values are identified, recorded, protected and interpreted.
- Natural geological and geomorphological processes continue to occur without human interference.
- The natural and historic heritage values of the reserve are protected, conserved and managed.
- The reserve conserves biodiversity, and negative conservation trends for threatened species are being reversed.
- State and national recovery plans for threatened species have been successfully implemented.
- A program (or programs) to eradicate rabbits, rats and mice from the reserve has been planned, funded, implemented and successfully concluded.
- Quarantine and environmental protection measures are effective and thoroughly applied, and have successfully prevented any further introductions of alien species.
- Those ecological processes and systems affected by direct or indirect human disturbance, particularly due to introductions of alien vertebrate species and some invertebrate species, are recovering their natural integrity.
- Human impacts resulting from commercial educational tourism, scientific and management programs are controlled and do not threaten the natural or historic heritage values of the reserve.
- The marine component of the reserve and the Macquarie Island Marine Park are managed in a complementary and cooperative manner by the state and the federal Governments, and contribute to the outcomes of the National Representative System of Marine Protected Areas (NRSMPA).
- Air, land and waters of the reserve are relatively unpolluted by human activities.
- The historic heritage of the reserve is identified, recorded, protected and interpreted.

4.3 Achieving the Vision

This management plan provides the policies and prescriptions that must be implemented in order to progress towards the vision for the reserve over the next seven years. Implementation of this plan by the Director of National Parks and Wildlife depends upon the Director's priorities, as well as the provision of adequate funding and resources. Implementation is also dependent, in part, on the continued logistic support of the Australian Antarctic Division, which is also constrained by priorities, funding and resources.

- Review the plan seven years after gazettal of its approval by the Governor, or sooner if research, monitoring, or other circumstances show this to be needed.

- As a minimum, use the performance indicators set out in Appendix 10 when evaluating the implementation of the plan and achievement of key desired outcomes.

- Utilise any relevant, additional monitoring and evaluation procedures developed during the period of the plan to evaluate implementation and outcomes.

4.4 Australian World Heritage Management Principles

The reserve is subject to four different management regimes in different jurisdictions. These management regimes are World Heritage, biosphere reserve, IUCN reserve and Tasmanian reserve management principles and objectives. Sections 4.4 to 4.8 indicate how this plan complies or gives effect to each of those four sets of principles and objectives.

The Australian World Heritage management principles are set out in Schedule 5 (Regulation 10.01) of the Environmental Protection and Biodiversity Conservation Regulations and reproduced below. The sections of this plan that give effect to all of the World Heritage principles of management are shown in brackets after each principle.

General principles

- The primary purpose of management of natural heritage and cultural heritage of a declared World Heritage property must be, in accordance with Australia's obligations under the World Heritage Convention, to identify, protect, conserve, present, transmit to future generations and, if appropriate, rehabilitate the World Heritage values of the property (Sections 5 and 6).

- The management should provide for public consultation on decisions and actions that may have a significant impact on the property (Section 7).

- The management should make special provision, if appropriate, for the involvement in managing the property of people who: (a) have a particular interest in the property; and (b) may be affected by the management of the property (Section 7).

- The management should provide for continuing community and technical input in managing the property (Section 7).

Management planning

At least one management plan should be prepared for each declared World Heritage property. A management plan for a declared World Heritage property should

> (a) state the World Heritage values of the property for which it is prepared (Section 1.3.1);

(b) include adequate processes for public consultation on proposed elements of the plan (Section 7.1);

(c) state what must be done to ensure that the World Heritage values of the property are identified, conserved, protected, presented, transmitted to future generations and, if appropriate, rehabilitated (Sections 5 and 6);

(d) state mechanisms to deal with the impacts of actions that individually or cumulatively degrade, or threaten to degrade, the World Heritage values of the property (Sections 5 and 6.3);

(e) provide that management actions for values, that are not World Heritage values, are consistent with the management of the World Heritage values of the property (Section 5);

(f) promote the integration of Australian State or Territory Government, and local government responsibilities for the property (Section 5.1 and 8.1);

(g) provide for continuing monitoring and reporting on the state of the World Heritage values of the property (Section 8);

(h) be reviewed at intervals of not more than seven years (Sections 1.5 and 8.5).

Environmental impact assessment and approval

This principle applies to the assessment of an action that is likely to have a significant impact on the World Heritage values of a property (whether the action is to occur inside the property or not). Before the action is taken, the likely impact of the action on the World Heritage values of the property should be assessed under a statutory environmental impact assessment and approval process (see Section 6.3).

4.5 Australian Biosphere Reserve Management Principles

To the extent practicable, this management plan provides for management of the reserve in accordance with the principles for biosphere reserves. These principles are set out in Schedule 7 (Regulation 10.03) of the EPBC Regulations and reiterated below. The sections of the plan that give effect to the principles of management for biosphere reserves are shown in brackets after each principle.

Management principles

- A management plan should be prepared for each biosphere reserve (Section 1.5).
- A management plan for a biosphere reserve should state:

  (a) the values for which the reserve is established (Section 1.3.2);

  (b) the extent of the reserve (Section 1.1);

  (c) any zoning that provides for the following functions (Section 6.2):

(i) conserving genetic resources, species, ecosystems and landscapes (Zones B and C)

(ii) fostering sustainable economic and human development (Zone A)

(iii) supporting demonstration projects, environmental education and training, and research and monitoring related to local, national and global issues of conservation and sustainable development (Zones A, B, C);

(d) the role of the reserve in contributing to a national coverage of ecological systems representative of major bioregions (Section 2.2);

(e) the strategies for biodiversity conservation in the reserve, including those that:

(i) protect it from disturbance and threatening processes (Section 5)

(ii) minimise potential adverse effects on its natural, cultural and social environment and surrounding communities (Sections 5 and 6);

(f) how the plan will provide for:

(i) exploring and demonstrating approaches to sustainable development on a regional scale (Section 6.2, in terms of sustainable development in the subantarctic)

(ii) ensuring that the health, diversity and productivity of the environment in the biosphere reserve are maintained or enhanced for the benefit of future generations (Section 5)

(iii) ensuring that decision-making is consistent with the precautionary principle (Section 6.3)

(iv) setting out an appropriate policy and management framework (Sections 2 and 4–8)

(v) programs for research, monitoring, education and training (Sections 6.8, 6.9 and 7).

- A management plan for a biosphere reserve should provide for public consultation about planning for, and proposed actions in, the biosphere reserve (Sections 6.3 and 7).

4.6 Australian IUCN Reserve Management Principles

This management plan provides for the management of the reserve in accordance with IUCN reserve management principles. These principles are set out in Schedule 8 (Regulation 10.04) of the EPBC Regulations. The sections of the plan that give effect to IUCN reserve management principles are shown in brackets after each principle.

The EPBCA requires that the management plan assigns an IUCN Category to the reserve. This plan assigns IUCN Protected Area Management Category 1a to the Macquarie Island Nature Reserve**.**

Management Principles for Category 1a – Strict Nature Reserves

The reserve or zone should be managed primarily for scientific research or environmental monitoring based on the following principles:

- Habitats, ecosystems and native species should be preserved in as undisturbed a state as possible (Sections 5 and 6).
- Genetic resources should be maintained in a dynamic and evolutionary state (Sections 5.2, 5.6 and 5.8).
- Established ecological processes should be maintained (Sections 5.2, 5.5, 5.6 and 5.8).
- Structural landscape features or rock exposures should be safeguarded (Sections 5.3 and 5.4).
- Examples of the natural environment should be secured for scientific studies, environmental monitoring and education, including baseline areas from which all avoidable access is excluded (Section 6.2).
- Disturbance should be minimised by careful planning and execution of research and other approved activities (Sections 6.3 and 6.8).
- Public access should be limited to the extent it is consistent with these principles (Sections 6.9 and 7).

4.7 Purposes and Objectives of Nature Reserves

Macquarie Island was originally reserved in 1933 specifically as a wildlife sanctuary. This management plan gives statutory effect to the management of Macquarie Island Nature Reserve and World Heritage Area in accordance with the principles of management for nature reserves, World Heritage Areas, biosphere reserves and IUCN Category 1a reserves. The managing authority, in this case the Director of National Parks and Wildlife, must give effect to this management plan in accordance with the following management purposes and objectives.

The purposes and objectives of management for nature reserves are set out in Schedule 1 of the Tasmanian *Nature Conservation Act 2002* and Schedule 1 of the Tasmanian *National Parks and Reserves Management Act 2002.* These two acts replace the Tasmanian *National Parks and Wildlife Act 1970.*

Class of Land

Nature reserves are a class of reserved land under the Tasmanian *Nature Conservation Act 2002*. They are areas of land that contain natural values that:

(a) contribute to the natural biological diversity or geological diversity of the land, or both; and

(b) are unique, important or have representative value.

Purposes

The purposes of reservation of nature reserves, as set out in Schedule 1 of the *Nature Conservation Act 2002*, are to conserve the natural biological diversity or geological diversity of the area of land, or both, and to conserve the natural values of those areas of land that are unique, important or have representative value. Macquarie Island Nature Reserve is reserved for all of these purposes.

Objectives for Management

The objectives for management of nature reserves are set out in Schedule 1 of the *National Parks and Reserves Management Act 2002*. Because of the complex interrelationship of factors to be considered in managing the nature reserve, the reasons these objectives apply and the manner in which the objectives will be achieved are dealt with in a number of sections of the management plan. The sections that primarily deal with each management objective in the Act are shown in brackets.

The management objectives of nature reserves are:

(a) to conserve natural biological diversity (Sections 5 and 6);

(b) to conserve geological diversity (Section 5.2);

(c) to preserve the quality of water and protect catchments (Section 5.5);

(d) to conserve sites or areas of cultural significance (Section 5.10);

(e) to encourage education based on the purpose of reservation and the natural or historical values of the nature reserve, or both (Sections 6.9 and 7);

(f) to encourage research, particularly that which furthers the purposes of reservation (Section 6.8);

(g) to protect the nature reserve against, and rehabilitate the nature reserve following, adverse impacts such as those of alien species, diseases, soil erosion and fire on the nature reserve's natural and historical values and on assets within and adjacent to the nature reserve (Section 5); and

(h) to encourage cooperative management programs with Aboriginal people in areas of significance to them in a manner consistent with the purpose of reservation and the other management objectives.

All of the general management objectives for nature reserves set out in the Act apply to the Macquarie Island Nature Reserve, apart from objective (h), as there are no known traditional links between Macquarie Island and Aboriginal people.

4.8 Specific Reserve Objectives

To maintain the particular reserve values, and to achieve the vision for the reserve, it is necessary to elaborate on the statutory management objectives for nature reserves. The following objectives expand and give emphasis to the statutory management objectives in the light of the particular features, circumstances, issues and values that prevail in the reserve, as identified in this management plan. These specific reserve objectives will be used in evaluating the performance of management in implementation of this plan (see Section 8.4 and Appendix 10).

- To protect and manage the reserve for the World Heritage values (geological and aesthetic) which led to its listing.
- To protect and manage the reserve as a natural habitat for its native flora and fauna.
- To gain a clear understanding of the conservation status of its flora and fauna, particularly those species known to be threatened or in decline in the reserve.
- To protect and preserve the marine habitat adjacent to the reserve for the majority of the native fauna.
- To conduct, promote and encourage research and studies, particularly those that contribute to the above specific objectives, in so far as they have no significant adverse impacts on the natural and historic values of the reserve, the surrounding seas and the region.
- To prevent further accidental introductions of alien plant species or fauna and to eradicate or control, as far as possible, previously introduced species that affect or endanger native species and habitats.
- To implement relevant national and state recovery plans.
- To facilitate and monitor the re-establishment and recovery of populations of species that were affected by alien species.
- To reverse the impacts of alien introductions to the reserve.
- To record, protect and/or preserve any historic localities, artefacts or relics found in the reserve or adjacent waters.
- To permit controlled educational tourism consistent with the protection of the natural and historical values of the reserve without compromising these values.
- To enhance the reserve's role in the UNESCO Man and the Biosphere Program.
- To enrich all human visitors' experiences of reserve values through education and interpretation.
- To develop public understanding of the values and goals for management of the reserve.

- To protect the conservation values of the marine environment, namely:
  - the only shallow water habitats existing in the Macquarie Island region, along with their associated flora and fauna;
  - wildlife access to the island, as well as the near-shore foraging areas and nursery areas, for vast concentrations of marine birds and mammals;
  - marine geological values, including those identified in the World Heritage listing.
- To work with the Australian Government to jointly manage and protect the WHA. including the waters to 12 nm.

5 Conservation and Protection of Reserve Values

5.1 Marine Environment Conservation and Protection

Conservation and protection of the marine environment are crucial to achieving ecosystem conservation for Macquarie Island Nature Reserve. The addition of state waters to 3 nm to the terrestrial reserve (see Section 1.2) recognised the inextricable link between the marine and terrestrial components of the reserve. That link is exemplified by the wildlife that breeds, moults and rests on the land and feeds at sea. The importance of that link to ecosystem conservation is also recognised in the inclusion of the waters to 12 nm in the Macquarie Island World Heritage Area. While the Macquarie Island Marine Park on the eastern side of the reserve includes these waters, the waters from three nm to 12 nm on the western side in the World Heritage Area (WHA) are not protected. While fishing occurs outside the reserve area, impacts from fishing on protected species through trophic interactions, direct impacts through bycatch and potential introduction of alien species to the reserve are issues that, potentially, could have potential impact on the reserve and its natural values (see Section 3.3).

The objectives, policies and actions for management of the marine areas around Macquarie Island are set out in Section 6.2.3. In brief, the Highly Protected Zone of the Macquarie Island Marine Park and the marine waters around Macquarie Island are managed primarily for protection of important foraging areas and a variety of benthic habitats from damage by human activities. In accordance with IUCN Category 1a management principles, these waters will be managed primarily for scientific research and environmental monitoring. No fishing or resource extraction will occur. The northern and southern Species/Habitat Management Zones of the Marine Park will be managed to ensure the maintenance of habitats or to meet the requirements of collections of specific species (EA 2001) (see Map 2).

A Memorandum of Understanding has been developed between the federal and state governments to facilitate joint management (Section 8.1). Management for human use of the marine environment is described in various parts of Section 6, including emergency management in the event of an oil spill.

Section 8.1 also recommends adding the marine areas of the reserve and the WHA to the Register of the National Estate to complement the terrestrial and intertidal habitats of the reserve already listed. The Macquarie Island biosphere reserve should also be extended to include the protected areas of the surrounding marine environment. As a biosphere reserve (Section 1.3.2), incorporating these areas means that the objectives of studying ecological interactions and monitoring global change can be more fully realised. While regional arrangements can be very complex and are beyond the scope of this plan, complementary management of Australia's and New Zealand's adjacent 200 nm zones around Macquarie Island, Campbell Island and Auckland Islands could make a significant contribution to marine wildlife conservation in this part of the Southern Ocean.

The Australian Government has obligations under Section 173 of the *Environmental Protection, and Biodiversity Conservation Act 1999* (EPBCA) to identify and state the

range of cetaceans in Australian Government marine areas. These records provide baseline information for monitoring. A quantitative baseline biological assessment of the coastal waters would be useful in detecting changes in community structure of coastal ecosystems. Long-term quantitative monitoring would provide valuable information in the event of an oil spill or similar accident, as well as a basic understanding of the coastal ecology of the reserve (see Table 3 in Section 6.8).

5.2 Geoconservation

Macquarie Island is a geological wonder of World Heritage value (see Section 3.6). The rocks provide the foundation for the development of the landforms, soils, plants and animals that, as a whole, create one of the truly remarkable places on Earth. It exemplifies the importance of appreciating the entire environment when considering conservation and protection of its values. The diversity of earth features or geodiversity and therefore biodiversity makes Macquarie Island an island of unique natural diversity. It is a site of global geoconservation significance.

Objectives –Geoconservation

The objectives for geoconservation in the reserve are to:

- protect WHA geoconservation values;
- protect, maintain and monitor geodiversity;
- protect, maintain and monitor sites of geoconservation significance;
- maintain natural rates and magnitudes of change in earth processes;
- avoid harmful impacts on geoconservation values;
- encourage geoscientific research that is consistent with the values for which the area was nominated for World Heritage listing; and
- maintain a high standard of geointerpretation for visitors including up-to-date booklets and other interpretive material as required.

Policies

- Potential adverse impacts on geodiversity and earth processes will be assessed when planning any development or action, including land rehabilitation and stabilisation (see Section 6.3).
- Management practices and development will avoid or otherwise minimise impacts on the integrity of sites of geoconservation significance.
- Scientific research will be conducted in a way that avoids adverse impacts on geodiversity, sites of geoconservation significance or the aesthetics of significant

exposures. Geoscientific research must be consistent with the World Heritage values for which the area was nominated and must be justified in this context.

- The use of coring devices and other mechanical sampling devices for geoscientific research will not be permitted unless special permission is provided. Any approval will be controlled and monitored. Similar conditions will apply to the use of explosives for geoscientific or management purposes.

- All scientific applications for research, including geoscientific research, must be assessed and approved as set out in Section 6.8 of this plan.

Actions

- Prepare a geoconservation management strategy that identifies sites of geoconservation significance, maps locations accurately and provides management recommendations.

- Ensure that scientific collection permits have appropriate conditions to avoid or minimise impacts of collecting on geological outcrops and other geological, geomorphological or soil features.

- Closely assess, scrutinise and monitor scientific permits in order to ensure impacts on geodiversity and World Heritage values are avoided.

- Assess and, if appropriate, monitor human impacts on soils and landforms.

- Assess and, if appropriate, monitor the impacts of global climate change on coastal and periglacial features and landforms.

- Ensure that high-quality interpretation of the World Heritage values of the reserve is provided to Australian Antarctic Program (AAP) personnel and visitors.

5.3 Landscape Values Conservation and Protection

Objectives – Natural and Cultural Landscape

The objectives for the conservation and protection of natural and cultural landscape are to:

- protect, maintain and monitor the World Heritage values of the natural landscape;

- identify, conserve, protect and monitor the cultural landscape; and

- protect scenic values.

Policies

- The natural and cultural landscape values of the reserve will be protected and conserved through appropriate zoning and development controls (see Sections 6.2 and 6.3).

- Cultural landscape management will be based on the identification, management and maintenance of significant cultural landscapes and the identification and protection of views of heritage significance.
- Relevant archaeological, historic heritage, botanical and zoological information will be used in developing cultural landscape management programs.
- Cultural landscape maintenance and renewal will be based on evidence from historic photographs and the historic layout of these areas.
- Any new field huts will be coloured to blend in with the surrounding landscape.
- New public memorials or commemorative plaques may be placed in the reserve with the permission of the Director.

Actions

- Identify and protect the significant natural landscape features and attributes that contribute to the World Heritage values of the reserve as a natural landscape.
- Identify, record and assess the significance of cultural landscapes.
- Assess the visual impact of proposed developments on natural and cultural landscape values prior to approval of such developments.
- Identify, record and assess the significance of cultural landscapes in the reserve.

5.4 Landscape Rehabilitation

The World Heritage landscape values of the reserve are affected by natural erosion, landslips and damage caused by rabbit grazing and human activities. Continual winds, seismic activity, freezing and thawing, constant precipitation and rabbit grazing are the major forces affecting soil stability.

Erosion and damage to the landscape is also caused by human activities, including station use and development, use of walking tracks and field huts. The old tip site on the Isthmus has been cleaned up and covered with soil and vegetation, but occasionally a severe storm will wash some of the cover away. Walking track management and rehabilitation is dealt with in Section 6.10. Currently impacts around field huts are minimised as far as possible.

Objectives – Landscape Rehabilitation

The objectives of landscape rehabilitation are to:

- protect World Heritage landscape values;
- protect natural landscape processes; and

- minimise, and rehabilitate where necessary and appropriate, damage caused by human activities.

Policies

- Natural rehabilitation will be allowed to occur where possible.
- Where necessary and appropriate, with advice from Department of Primary Industries and Water (DPIW), active rehabilitation may be undertaken on sites damaged by human activities where natural rehabilitation is not occurring, following site monitoring for at least one year.
- Active rehabilitation must be undertaken as set out in the Tasmanian Reserve Management Code of Practice (PWS et al. 2003).
- Active revegetation and rehabilitation programs will use only local provenance of species.
- Any works or rehabilitation plans must consider how wildlife will affect, and be affected by such works.
- Researchers will be encouraged to consider the likely impacts of their access to research areas and the conduct of their work. Proposals must describe means of ameliorating or minimising those impacts.

Actions

- Identify locations where active rehabilitation may be required due to damage from human activities.
- Continue to monitor natural rehabilitation of sites where field huts have recently been removed.
- Monitor the extent of disturbed areas on the Isthmus.
- In places where vegetation and underlying soils have been destroyed on tracks, measures should be taken to encourage natural revegetation.

5.5 Water Quality Conservation and Protection

The *State Policy on Water Quality Management 1997* requires that water quality objectives and protected environmental values are set for all surface waters in the state. Although they do not fit in with the reserve neatly, the following standardised values have been set for Macquarie Island Nature Reserve as one of the state's reserves located in the Huon Valley Municipality (DPIWE 2003a). It should be noted that the following only applies to those waters in the reserve that are not used as moulting or wallowing sites by wildlife.

A: Protection of Aquatic Ecosystems

(i) Protection of pristine or nearly pristine ecosystems

Having regard for the management objectives for national parks, State reserves, nature reserves or historic sites as outlined in Schedule 1 of the *National Parks and Reserves Management Act 2002*.

B: Recreational Water Quality and Aesthetics

(i) Primary contact water quality (not permitted in the reserve)

(ii) Secondary contact water quality (not permitted in the reserve)

(iii) Aesthetic water quality

That is, as a minimum, water quality management strategies should seek to provide water of a physical and chemical nature to support a pristine or nearly pristine ecosystem; and which will allow people to safely engage in recreational activities such as swimming, paddling or fishing in aesthetically pleasing waters (these activities are not permitted in the reserve).

Objective – Water Quality

- To maintain or enhance water quality in the reserve.

Policies

- Designated protected environmental values will be adopted as the minimum standard for water quality.

Actions

- Ensure developments or human activities do not compromise water quality.

5.6 Flora Conservation and Protection

Rabbit grazing has had a significant impact on the vegetation of the island (Taylor 1955; Copson & Whinam 1998), with extensive modification of natural communities. Heavy rabbit grazing often results in the destruction of tall tussock grassland and herbfields, resulting in the reduction of their value as burrow-nesting seabird habitat and increasing the risk of landslips on steep slopes. Selective grazing of plant species occurs in many communities, allowing less palatable species to become dominant. Eradication of rabbits is essential to reverse impacts on vegetation (see Section 5.9).

Modification of vegetation will occur with global climate change. On Macquarie Island, this may result in upward expansion of lower-altitude plant communities, and the potential loss of species currently restricted to higher altitudes (Kiefer 2002). In terms of

threats to conservation values, warmer temperatures are likely to increase the ability of alien plant species to establish and proliferate (Bergstrom & Chown 1999). As removal of aliens can be both expensive and difficult, this highlights the need for effective enforcement of quarantine measures (see Section 6.6) and continued monitoring.

The Royal Tasmanian Botanical Gardens (RTBG) in Hobart houses a valuable Macquarie Island plant collection in its Subantarctic Plant House. It contributes to ongoing and new botanical research, providing an off-site resource for research on species cultivation, morphology and climate change monitoring.

Objectives – Flora Conservation

The objectives for flora conservation in the reserve are to:

- protect, monitor and conserve plant biodiversity;
- identify, protect, maintain and monitor sites of conservation significance, including values that may meet additional criteria of WHA listing;
- minimise human impacts on vegetation;
- monitor changes in vegetation with changes in rabbit population size; and
- encourage botanical research in plant biodiversity, conservation and management.

Policies

- Plant biodiversity will be protected and conserved by using remaining stocks of *myxoma* virus as effectively as possible until such time as an appropriate rabbit eradication method can be implemented.
- Vegetation will be protected from further adverse impact due to human use of the reserve by education of all visitors, careful track placement, adequate track maintenance and track marking (see Section 6.10).
- Adverse impacts in areas such as feldmark communities and the “featherbeds” will be avoided or limited to those that are localised and of minimal impact.
- Where natural revegetation fails to occur in damaged areas, local provenance of species native to the reserve will be used in rehabilitation and revegetation work.

Actions

- Support ongoing and new botanical research in the reserve’s plant biodiversity, conservation and management.
- Continue and encourage long-term monitoring programs, including those assessing changes in the distribution and status of both native and non-native species (plants and animals) brought about by changes in alien fauna and flora, climate change or other anthropogenic influences.

- Prepare and/or implement management programs for rare plant species.
- Contribute to assessment of impacts of proposed developments and/or activities on flora conservation values.
- Participate in reviews of quarantine procedures with DPIW, Australian Antartic Division (AAD), RTBG and Quarantine Tasmania.
- Ensure that scientific permits contain appropriate conditions to minimise impacts on flora values and to minimise the risk of alien species and pathogens.
- Develop State of the Environment indicators that are of value in assessing and monitoring changes in plant biodiversity and facilitating management decisions.

5.7 Alien Plant Species Management

Strict quarantine measures (see Section 6.6) are essential for preventing the transport of alien species to the subantarctic in cargo, food and equipment, including personal clothing and gear. In a recent study (Whinam et al. 2002), a total of 981 propagules and five moss shoots were collected from clothing and equipment of 64 expeditioners. In germination trials a total of 163 plants (24 species) were identified. A risk assessment was prepared to determine issues posing a threat to subantarctic quarantine and assess possible logistic and management changes to minimise these threats. Many changes suggested have since been implemented, resulting in a reduction in the number of alien species recorded in subsequent inspections.

In order to protect Macquarie Island plants from the risk of introduced insect pests and establishment of non-native plants, fishing operators are required to ensure that no brassicas (broccoli, cabbage, Brussels sprouts or kale) are discharged while in the waters around Macquarie Island. Other users of the Macquarie Island region should be encouraged to adopt similar responsible measures to reduce the risk of alien introductions.

The distribution and status of alien plant species will continue to be monitored. When new species are detected and it is considered or proven that such species were introduced by human activities, or they pose a threat to native vegetation or fauna, or the Director considers that they are inconsistent with the natural values of the reserve, they will be removed or destroyed at the discretion of the Director, following consultation with the appropriate scientific experts. This may only be undertaken by authorised officers using methods that are practical and appropriate for the reserve.

Objectives – Alien Plant Species Management

The objectives for alien plant species management are:

- to prevent the risk of introductions and subsequent establishment of alien plant species;
- to eradicate where possible, or control, alien plant species; and
- to monitor the effects of alien plant species on the ecosystems of the reserve.

Policies

- Eradication or control of alien plants will only be attempted where potential risks posed by the proposed eradication methods to non-target species are less than the potential risks to the ecosystem from the alien plants.

- Alien plant eradication, control, and containment actions and priorities will be based on the results of current research or, where necessary, additional research.

Actions

- Monitor the distribution of alien plant species currently within the reserve.

- Continue vigilant monitoring of the reserve for new alien plant species, particularly at the main visitor landing sites.

- Prepare management programs, in consultation with scientific experts and staff at the RTBG, for any alien plant species where monitoring suggests the species would favourably respond to active management intervention.

5.8 Fauna Conservation and Protection

Conservation and protection of the native fauna of the reserve is reliant upon protection of their habitat (terrestrial and marine) as well their protection from the impacts of alien species (see Section 5.9). Where vulnerable species or their habitats are threatened by predation and/or habitat destruction, special measures must be taken in order to meet obligations under national and state threatened species legislation (see Section 3.10.1). The threat to several seabird species in the reserve from by-catch as a result of commercial fishing in habitat west of the reserve is of concern. Fishery management measures and the current strategic assessment of the fishery being undertaken by Department of Environment and Heritage (DEH) are designed to protect the biodiversity of the region, particularly threatened species, from the impacts of fishing.

A number of national recovery plans, action plans and threat abatement plans have been produced by the DEH that are relevant to the protection and conservation of threatened species and the management of alien species of Macquarie Island (see Section 2.2). These include:

Recovery Plan for Albatrosses and Giant Petrels 2001

Recovery Plan for the Southern Elephant Seal and Subantarctic Fur Seal (in preparation)

Action Plan for Australian Birds 2000

Action Plan for Australian Seals 1999

Threat Abatement Plan for Predation by Feral Cats 1999

Threat Abatement Plan for Competition and Land Degradation by Feral Rabbits 1999

Threat Abatement Plan for the Incidental Catch (or Bycatch) of Seabirds During Oceanic Longline Fishing Operations 1998

Action Plan for Australian Cetaceans 1996

Macquarie Island was listed on the Register of Critical Habitat under the EPBCA, as habitat critical to the survival of the wandering albatross and the grey-headed albatross (see Section 3.10). This plan provides for critical habitat protection through management zoning and the ability to designate Special Management Areas (Section 6.2.4). Other measures to conserve and protect fauna from undue human disturbance and to interpret fauna values are provided throughout Sections 6 and 7.

Objectives – Fauna Conservation and Protection

The objectives for fauna conservation in the reserve are to:

- protect, maintain and monitor all fauna species that are native to the reserve, particularly those that are listed as threatened (see Appendix 4);
- to gain a clear understanding of the conservation status of native fauna, particularly those whose conservation status is unknown or threatened;
- protect, maintain and monitor the diversity of native fauna and habitat;
- identify and mitigate harmful impacts on native fauna and habitats; and
- provide opportunities for visitors to view and encounter wildlife in ways that avoid disturbance.

Policies

- Recovery plans, action plans and threat abatement plans will assist in guiding the conservation and management of threatened species.
- Any native vertebrate species whose status in the reserve is either uncertain or threatened will be monitored.
- Research on these species will be restricted to minimum impact studies, undertaken to provide data for future management programs that are designed to enhance the conditions for recovery of the species in the reserve.
- Some habitats may be designated as Special Management Areas (SMAs) as deemed necessary by the Director (see Section 6.2.4, Map 11).
- Access may be restricted by the Director based on scientific advice as required to provide added protection to species whose status in the reserve is either threatened or uncertain, or vulnerable to human disturbance.

- Scientists and others undertaking programs in the reserve that may be affected by access restrictions will be notified and consulted as early as possible to enable program planning around these restrictions.

- The timing of research programs and any recreational use of the reserve will minimise impact on breeding wildlife.

- All practicable efforts will be made to avoid human impacts on breeding success and survival of threatened species and species considered vulnerable to human disturbance.

- Visits to coastal breeding bird areas may be limited or access restricted if monitoring shows disturbance of breeding.

- Guidelines for wildlife viewing, minimum approach distances and minimal impact will be provided to all visitors to the reserve and may be changed by the Director upon advice from the Secretary as required to protect wildlife. All AAP personnel and tourists will be informed of any changes as soon as practicable.

Actions

- Seek advice from the Secretary to establish and report on the conservation status and research priorities for vertebrate species (see Section 6.8).

- Set priorities for threatened species management, having regard to international and national priorities, recovery plans, action plans and threat abatement plans. Keep those priorities under annual review.

- Monitor the population trends of all native fauna, particularly threatened species and species considered vulnerable to human disturbance.

- Implement the relevant prescriptions of recovery plans and action plans for threatened species. Support research programs that do this.

- The Director will develop a response plan for reports of unusual animal deaths or evidence of animal disease. In the interim, the Director will rely on the draft response plan developed by the AAD to the extent that it is applicable (see Section 6.16.3).

- Monitor human impact on wildlife, particularly adherence to minimum approach distance guidelines provided by the Director upon advice from DPIW.

- Review minimum approach distance guidelines and wildlife viewing guidelines as necessary to minimise human impacts on fauna, particularly threatened species.

- Identify and mitigate anthropogenic influences that adversely affect native fauna, especially threatened species.

- Maintain liaison with fisheries management agencies and advisory bodies, such as the Subantarctic Fishing Advisory Group, to ensure appropriate mitigation measures are in place in fisheries operating in areas that are frequented by marine birds and mammals from Macquarie Island who are susceptible to by-catch.

- Encourage measures to minimise accidental bird strikes on masts, guy wires, and wind generators on the station and at field huts.

- Ensure that bird strikes at the station or in the field are logged (see AAD 2003) and reported to the Ranger in Charge (RIC). Data from logging forms will be provided to the Director and the Secretary, DPIW.

- Conduct fauna surveys to fill gaps in knowledge useful for management and protection, including nearshore marine ecosystems.

- Continue monitoring for windborne invertebrates.

- Management staff will continue to collect cetacean siting records from the reserve and, where feasible, on voyages to and from the reserve. Copies of these records should be provided to, the Secretary, DPIW, and to the Whale and Dolphin Conservation Society.

5.9 Alien Fauna Management

Like many other islands, the native flora and fauna of Macquarie Island have been affected by the introduction of alien animal species (Table 1). Since 1972 research has been undertaken and management strategies developed and implemented to reverse the impacts of alien introductions (Brothers & Copson 1988; Copson 1995a; Copson & Whinam 2001). Research has been conducted on some alien invertebrate species, but to date no management strategies have been developed or implemented.

Eradication of rabbits, rats and mice from the reserve is the highest priority for management. Alien fauna eradication planning and implementation, such as that successfully undertaken in 2000 on Campbell Island, New Zealand (Department of Conservation (DOC) 2000; DOC 2003), is urgently required. Securing funding for such an eradication operation will be a priority and a challenge for management.

Rabbits

Rabbits were introduced in the 1870s (Cumpston 1968) and have had major impacts on most of the reserve's plant species (Taylor 1955; Copson 1984; Copson & Whinam 1998), which in turn has had a devastating impact on the population of many burrowing seabird species through habitat destruction. Some plant species, such as *Pleurophyllum hookeri* and *Stilbocarpa polaris*, are heavily grazed to the extent that they have become locally extinct from some sites on the island. Many areas of shorter grassland on coastal slopes appear to be in a state of change from one community to another as a result of heavy grazing by rabbits. In 1978 the rabbit population was estimated at 150,000 animals Copson et al. 1981). A control program was commenced in the summer of 1978–79 and within 10 years the population was reduced by around 90% (Brothers et al. 1982) to an estimated 3,300 animals, resulting in rapid recovery of most plant communities as well as changing the status of individual plant species (see Section 3.9) (Copson & Whinam 1998, 2001).

Table 1 Alien Vertebrate Fauna Established on Macquarie Island

Species	Date of Introduction	Current Status	Current Management Approach
Feral cat	Before 1820	Formerly W, now E	Last record June 2000
Weka	1870s	E	Last record December 1988
European rabbit	1878	W A	Control program – under review
Ship rat	1890s	W A	Research into impact/local control – under review
House mouse	1890s	W A	Local control, with rats – under review
Redpoll*	Before 1912	W A	Obtaining data on diet, low priority
European starling*	Before 1930	W A	Obtaining data on diet, low priority
Mallard*	Before 1950	W C	Recording distribution/abundance

Legend: W - widespread; A - abundant; C - common; E - eradicated; * - self introduced from Copson and Whinam (2001).

The general pattern of the rabbit population has been fluctuating between 5,000 and 20,000 over the years since the control program began (Kirkpatrick & Scott 2002). The rabbit population has continued to be controlled by annual reintroductions of *myxoma* virus and this has been a key to eradication programs for the introduced weka and feral cats. However, *myxoma* virus is no longer being manufactured in Australia and an alternative biological control is not available. There are plans to investigate the susceptibility of the rabbits to c*alicivirus* at Macquarie Island (Copson 2002). Eradication measures are currently the only alternative, and will be required in the immediate future to achieve the long-term vision of conservation of natural diversity in the reserve.

From a low in the 1980s, the rabbit population of Macquarie Island appears to have increased again, which may be attributable to cat eradication, warmer drier weather and the possible reduction in effectiveness of biological control methods (Scott, Shaw. pers comm.). An estimate of the rabbit population in 2002 was 16,000 (Copson 2002). Springer (2001) listed areas where significant damage had occurred, noting particularly the southern slopes around Hurd Point and Green Gorge. Reports from scientists working in the reserve over the 2002–03 summer indicate that rabbit grazing pressure has significantly altered the vegetation and appearance of the reserve (Amey, Scott pers. com.). In some places, burrowing activity and loss of vegetation have contributed to landslips and slope instability, increasing the potential to impact on the breeding success of several albatross species.

Cats

Feral cats were first recorded on Macquarie Island in 1820 (Debenham 1945) and caused considerable reductions in the populations of all species of the smaller seabirds breeding on the island. By the 1960s white-headed petrels, Antarctic prions and sooty shearwaters, all summer breeders, were the only burrow-nesting petrels still found extensively on the island (Jones 1977; Brothers 1984). In contrast, fairy prions, blue petrels and common diving petrels, formerly year-round residents, were only found in remnant populations on offshore sea stacks (Brothers 1984). Winter-breeding grey petrels were exterminated as a breeding species in the reserve. A study of feral cats in 1974 concluded that there were up to 500 individuals on the island and, while their main food source was the introduced rabbit, they continued to take up to 60,000 burrow-nesting seabirds annually (Jones 1977). It was evident that long-term survival of these seabirds depended on control/eradication of the cats (Brothers et al. 1985).

A feral cat management program commenced in 1985. A feral cat threat abatement plan (Scott 1996) was prepared and in 1998 a Natural Heritage Trust grant was obtained to intensify the field effort dramatically through an increase in shooting, poisoning, trapping and, from November 2000, searching for any remaining cats with dogs. The last cat was destroyed in June 2000 and cats were declared to be successfully eradicated in September 2002. However, monitoring will continue for several years. The first conservation outcomes from this program have been very rapid with some bird species, previously only found breeding on offshore seastacks, returning to breed on the main island in 2000. Grey petrels were found breeding in the reserve in 2000 for the first time since the 1890s and the new colony of grey petrels on North Head is expanding.

Wekas

Wekas *(Gallirallus australis scotti)*, a flightless rail, were introduced from New Zealand in the mid-1800s as a source of food for the sealers (Cumpston 1968). Taylor (1979) considered that they probably contributed significantly to the extinction of two endemic subspecies, the Pacific banded rail *(Rallus philippensis macquariensis)* and the Macquarie Island parakeet *(Cyanoramphus novaezelandiae erythrotis)*. It was estimated that there were at least 1,000 wekas in the reserve in 1979 but by 1984, after five years of rabbit control, the number of wekas on the island had dropped significantly, almost certainly due to feral cats using them as an alternative food source as rabbit numbers declined (Copson 1995b). An eradication program was commenced in 1985, which resulted in the last recorded weka being destroyed in 1988.

House Mouse and Ship Rat

Studies have been undertaken into the biology of the introduced house mouse and ship rat on the island (Copson 1986; Pye 1993, 2000). These showed that the mice feed mainly on invertebrate material while ship rats eat mostly plant matter, although the rats do have localised seasonal impacts on the smaller breeding seabirds (Copson 1986). The main habitat for rats on the island is the tall tussock grassland, a plant community that expanded following rabbit control, although the recent increase in grazing pressure is slowing this trend. When tussock grassland expands, it is likely to result in the rats coming into contact with currently isolated breeding colonies of Antarctic prions. As part of the restoration program for the island, localised control of rats has been carried out

around vulnerable colonies of burrow-nesting seabirds (Bryant 1994) trying to re-establish on the main island. A draft plan to eradicate rabbits and rodents has been prepared and submitted to DEH (Copson 2004). That plan also considers the possibilities for targeting rabbits in the same operation. A massive aerial poisoning program was conducted on Campbell Island in 2000. After months of thorough on-ground searches conducted in 2003, the program was declared successful (DOC 2003). Campbell Island is of a similar size and terrain to Macquarie Island, so the eradication program used could provide the basis for a similar program on Macquarie Island.

Monitoring Alien Fauna Management

An integral part of the alien fauna management program is studying the responses of native and alien species to changes in the status of those species being targeted, i.e. cats and rabbits (Copson 1995c). This includes long-term programs to monitor vegetation changes, the abundance and distribution of burrow-nesting seabirds and rabbit numbers. This provides information not only on the progress of a control/eradication program, but also on the overall objective of the program, i.e. the recovery of native species and ecosystems. It also allows for an adaptive approach and management changes to eradication/control programs that may be required as a consequence of species recovery or population increase.

Summary

In summary, some alien fauna species have had a major impact on the natural ecosystems of the reserve. The combined effect of the eradication of cats, warm weather and dry conditions has resulted in a substantial and rapid increase in the rabbit population. The increase in rabbit numbers could also be due to a reduction in the effectiveness of the *myxoma* virus or lesser amounts of virus being distributed between 1997 and 2000. The combination of these factors has resulted in extensive damage to the vegetation from rabbit grazing, particularly on the southern slopes of Macquarie Island where, in large areas, megaherbs and tussocks have been destroyed. Loss of vegetation and burrowing activity may increase erosion and the possibility of landslips, particularly on steep slopes. The continuing impact of rabbits, rats and mice on the biodiversity of this World Heritage reserve must be addressed as an urgent priority for management.

Implementation of the draft plan for rabbit and rodent eradication should be undertaken as a matter of urgency.

Objectives –Alien Fauna Management

The objectives of alien fauna management in the reserve are to:

- eradicate alien fauna species where this is feasible and warranted by the damage being caused, or likely to be caused, by such operations.
- ensure that eradication operations have no long-term adverse impacts;
- control alien fauna where eradication is not practicable, but control is warranted; and
- monitor alien fauna species numbers and their impacts.

Policies

- Eradication of rabbits, rats and mice are the highest priorities for the reserve.
- The program for reducing the rabbit population as far as possible will be continued until eradication becomes possible. The present method of control by spreading myxomatosis each year will be continued until supplies of the virus are exhausted (expected to be in less than two years), after which other management approaches will be required.
- The loss of non-target species, including threatened species, in any eradication plan must be considered and the costs and benefits assessed. Any methods for achieving further control or eradication that will have tolerable effects on native fauna will be investigated and implemented where shown to be satisfactory and practical.
- Monitoring programs will be carried out or encouraged to assess the impact of existing and new alien animal species. Control or eradication programs may be implemented for such species by the Director provided practical and appropriate methods can be used.

Actions

- As a matter of the highest priority, prepare and implement a comprehensive rabbit, rat and mouse eradication program.
- Until such time as a combined rabbit and rodent eradication program can be undertaken, continue rabbit control as a high priority, using *myxoma* virus and the most effective available methods.
- As a matter of the highest priority, actively seek funding from both government and non-government sources for research, planning, implementation and monitoring of eradication programs.
- Continue rabbit control programs, particularly on the southern slopes of the island, until an eradication program can be implemented.
- Maintain a detailed record of all control methods used and of their effectiveness.
- Prepare management programs for any other alien fauna species which monitoring suggests require active management.
- Continue to monitor alien fauna populations in the reserve.

5.10 Historic Cultural Heritage Management

A brief history of human use of the reserve is given in Section 1.4 and the values of that heritage are described in Section 3.12. The remoteness of the reserve and its climatic conditions make the conservation and protection of the existing historic heritage in the reserve an important management issue. The cold, wet climate and salt-laden winds have caused deterioration of ironwork, collapse and redistribution of artefacts and hut materials

and the rotting of timbers. The local fauna has also had a detrimental effect on structural remains. The wallowing habit of elephant seals and the activity of large numbers of penguins in and around historic sites have caused considerable disturbance and deterioration. Plants can cause deterioration through root invasion, or they can provide some protection by covering sites. Human interference through souveniring of artefacts, permitted historical collection, and development works has perhaps had the greatest effect on the reserve's historic heritage. Environmental education has been important in reducing souveniring and disturbance of artefacts.

Conservation planning guidance for conserving Macquarie Island's historic cultural heritage is provided in Nash (2003). It provides statements of significance for each of the 11 sites identified in Zone B (see Map 4), as well as details of the conservation policies and strategies to be adopted for historic cultural heritage management. The statements of significance are included in this plan as Appendix 7. The Director of National Parks and Wildlife is responsible for historic cultural heritage management in the reserve, but it is crucial that cultural heritage specialists work closely with PWS and AAD to manage historic cultural heritage successfully in the reserve. Heritage assessment of current structures on the station has been undertaken by AAD (Vincent 2002). If any structures or facilities on the station are no longer required and the Director wants to retain them for use or for their historic values, then said Director will assume responsibility for their maintenance and management (see Section 6.12).

Potentially historic materials should be left *in situ* until advice through the Director has been obtained. Any human remains found that are not in a known burial location or are considered to be from the 1800s should be left *in situ* and the Tasmanian Heritage Office should be contacted for advice. An Aboriginal sealer was buried on Macquarie Island in 1877 and his remains would need to be dealt with by the appropriate Aboriginal heritage authorities.

Fencing to protect historic sites in the reserve has been largely unsuccessful due to damage caused by moulting elephant seals, storms and very high tides. The fencing around the historic site at the Nuggets washed away several years ago. Storms in June 2003 resulted in one of the iron digestors at West Beach, Hasselborough Bay being relocated 50 m down the beach.

Objectives – Historic Cultural Heritage Management

The objectives of historic cultural heritage management are to:

- record, monitor, maintain, repair, protect and conserve historic cultural heritage resources;
- provide protection for historic cultural heritage resources through enforcement of regulations relating to historic cultural heritage protection;
- increase the involvement of personnel in the identification, protection and promotion of places of historic cultural heritage value in the reserve;
- actively conserve and maintain the heritage integrity and quality of significant cultural landscapes, heritage structures and other heritage features;

- maintain the landscape and setting of cultural heritage resources;
- present and interpret historic cultural heritage; and
- exclude intrusive development and activities that may impact on historic cultural heritage sites.

Policies

- Irrespective of management zone, conservation and management of historic heritage in the reserve will adhere to the Burra Charter (Australia ICOMOS Inc 1999) and its associated guidelines.
- Historic cultural heritage management in the reserve will comply with Australian federal and state heritage legislation.
- Approval for any works impacting on historic cultural heritage resources will be sought from the Director of National Parks and Wildlife in accordance with Section 6.3 of this plan.
- Approval from the Director is required for the removal or discarding of any heritage material or features from the reserve.
- The Director will administer all substantive issues relating to heritage policy, cultural resource management and archaeological research in the reserve and maintain records to that effect.
- In order for existing historic cultural heritage material to retain its cultural significance, artefacts and physical remains will be maintained *in situ*.
- A conservation policy statement or conservation plan, including specific assessment of significance, will be prepared before any decisions about major works on, or use, removal or interpretation of individual elements of historic heritage. Such statements or plans will be prepared in accordance with the principles outlined in the Burra Charter, using the methodology outlined in Kerr (2000).
- Historic localities may not be disturbed other than for archaeological surveys or conservation work as approved by the Director.
- Conservation and maintenance works on the disused field huts at Sandy Bay and Lusitania Bay are the responsibility of the Director. Sandy Bay hut has higher priority due to its accessibility to personnel and tourists and its educational value.

Actions

- Nominate the 11 significant historic places on Macquarie Island for inclusion on the Tasmanian Heritage Register under the Tasmanian *Historic Cultural Heritage Act 1995*.

- Consider nomination of the 11 significant historic places on Macquarie Island to the new Australian Government National Heritage List as one of the earliest industrial sites in Australia.

- Liaise with the AAD and the Queen Victoria Museum in Launceston in regard to conservation of historic cultural artefacts on the station.

- Maintain records of management of historic cultural resources, undertake an annual audit of identified cultural heritage resources on the island and update threat lists and condition statements.

- Ensure that induction and environmental education training for all personnel and visitors to the reserve includes historic cultural heritage education and highlights the importance of protecting remaining historic evidence.

- Use the Historic Artefact Reporting Form (Nash 2003) to record any new discoveries. Artefacts must remain *in situ* and may only be moved if they are subject to an immediate threat, such as wave wash.

- Make safe any dangerous structures, in keeping with their heritage significance.

- Provide access to historic cultural heritage resources by tourists and personnel and use interpretive material and site infrastructure to link historic sites across the reserve.

6 Management of Human Use

6.1 Administration and Management Responsibilities

The Director of National Parks and Wildlife is the managing authority for the reserve under the *National Parks and Reserves Management Act 2002 (NPRMA)*. The reserve is currently administered as a part of the Southern Region of the Parks and Wildlife Service (PWS).

Due to the isolation of the reserve, special arrangements are necessary for the staffing and daily administration of the reserve. The PWS Ranger-in-Charge (RIC) stationed at Macquarie Island is directly responsible for day-to-day management of the reserve. PWS has an office at the station on the Isthmus. The Station Leader (SL) is employed by the Australian Antarctic Division (AAD) and is responsible for management of the station and all personnel. The RIC and the SL work cooperatively to manage human activities in the reserve.

The AAD provides facilities and logistic support for Australian Antarctic Program (AAP) personnel working on the island, which may include PWS and Department of Primary Industries and Water (DPIW) personnel. Occasionally tourist ships and fishing vessels assist in transport.

The AAD has developed an Operations Manual (AAD 2003) that sets out the environmental management system in place for giving effect to AAD's Environmental Policy (AAD 2001b). It provides specific details on policies, procedures, roles, responsibilities and reporting. Activities relevant to Macquarie Island include quarantine, environmental emergencies, hydroponics, vehicle use, fuel management and waste management. The SL is responsible for ensuring AAP personnel and their activities comply with the relevant policies and procedures set out in the Operations Manual.

The Biodiversity Conservation Branch of DPIW is actively engaged in conservation management and research programs in the reserve. The Secretary of DPIW provides specialist advice to the Director on conservation and management activities relating to geoscience, flora and fauna research, quarantine matters and educational tourism.

Objectives – Administration

The objectives of administration of the reserve are to:

- implement this management plan;
- protect and conserve its World Heritage, biosphere reserve, nature reserve and National Estate values;
- coordinate and integrate scientific research, monitoring and management activities;
- ensure management responsibilities are efficiently and effectively carried out;

- ensure public safety and prompt response in emergencies in cooperation with AAP personnel; and
- enforce the provisions of this management plan and relevant Acts and Regulations.

6.2 Management Zoning

Although the vision, management principles and management objectives (Section 4) apply to the entire reserve, different conditions prevail in different parts of the reserve. To ensure appropriate management of these differing conditions, three management zones, special management areas (SMAs) and tourism management areas (TMAs) have been designated to manage human use of the reserve and to take account of and protect reserve values (see Map 10).

Objectives – Management Zoning

The objectives of the management zoning are to:

- ensure sensitive areas of the reserve are protected from undue human impact
- protect reserve values by concentrating and directing human impact in designated locations
- protect sites and species (including their critical habitats) that are vulnerable to human disturbance, through the declaration of SMAs where deemed appropriate;
- minimise the risk of introduction of alien species to the reserve through human activity.

Policies

- In accordance with Section 37 of the NPRMA, Macquarie Island Nature Reserve (which includes the surrounding waters to 3 nm) is declared a Restricted Area to which the public has not a general right of access (see Section 6.4).
- Except in an emergency, the maximum number of people staying overnight on the island will be 80 (this is a maximum of 60 people on station and 20 people in the field huts during changeover and resupply operations).
- Three management zones are designated for the Macquarie Island Nature Reserve (see Map 10).
- SMAs may be declared in any of these zones to further manage access in certain areas and/or at certain times to protect natural and historical values (see Section 6.2.4). These areas will be reviewed annually.
- TMAs (Maps 13–15) in each zone are specified for commercial educational tourism access (see Section 6.2.5).

- Each of these zones and areas will be managed in accordance with the objectives given in the following sections and summarised in Table 2.

6.2.1 Zone A – Services Zone

Zone A covers a section of the Isthmus, bounded on the coastal sides by the high water mark and on the northern and southern ends by straight lines running through suitably placed permanent marks to the low-water mark (see Map 12). It does not include Gadget Gully. The AAD has set limits to the station. Travel beyond these limits requires permission from the SL. At present, the boundaries of Zone A and the station limits do not coincide (see Map 12). The beach areas in this zone are important resting and moulting areas for elephant seals, fur seals, gentoo and rockhopper penguins and other seabirds.

Zone A allows for the construction and/or placement of buildings, facilities and scientific equipment necessary to carry out approved scientific data collecting and management programs. Zone A also provides the main living, working and logistic support facilities for personnel working in the reserve.

Over winter, the number of personnel in the reserve has historically been about 20. The greatest period of human activity occurs between September and April each year. During changeover of personnel and resupply of the station the number of people working on the island can exceed 60. These peaks put high pressures on station facilities, tracks and field huts. Human visitation in the summer months coincides with the highest influx of wildlife to the reserve and the greatest period of wildlife activity (courtship, breeding, egg laying/hatching, feeding young, moulting, resting, etc.). During the breeding season, the beaches on either side of the Isthmus are occupied by the largest concentrations of elephant seals in the reserve. Gentoo and rockhopper penguins, kelp gulls and fur seals also breed within Zone A.

Tourist visits also occur in the summer months, but these are only for a few hours, duration on a given day (see Section 6.9 and Appendix 8). A TMA is located on the southern end of Zone A, providing limited facilities for tourist visits in the form of walkways, viewing platforms, interpretation material and an emergency campsite (see Section 6.2.5).

Objectives – Zone A – Services Zone

The objectives for Zone A are to:

- concentrate most of the human impact and activity in the reserve, as far as possible, in one location;
- provide a site which is accessible, safe and relatively robust for human use;
- minimise the impacts of station facilities, development and human activity on local wildlife populations; and
- protect the breeding, moulting and resting site in the reserve for elephant seals and to protect other wildlife in the zone.

Policies

- Access to Zone A for resupply and logistic purposes may be across any of the beaches adjacent to the zone, providing disturbance to all birds and seals is kept to an absolute minimum.

- Liaise with the AAD to ensure that existing infrastructure is efficiently utilised and consolidated where possible, to reduce the number of structures and the amount of space occupied by the station.

- The Director may exclude areas within the boundaries of Zone A from any development or disturbance where it is thought necessary to protect wildlife, flora, natural values or historic locations of special significance. As the delegate of the Director, the RIC will establish any additional access restrictions (beyond any established SMAs) as needed and in consultation with the station environment committee. The RIC will be a member of that committee.

- In order to provide free access for wildlife between beaches on either side of the Isthmus and/or breeding areas on the Isthmus, no more than one quarter of the area of Zone A may be occupied by buildings, facilities, scientific equipment or enclosures protecting the same.

- No single obstruction, whether comprising an enclosure, a connected group of buildings, a single building, experimental sites, site services and facilities or any combinations of these, may extend for over 200 m in a north-south direction without a 50 m gap allowing access for wildlife.

- Unconnected groups of buildings, experimental sites, exclosures, site services and facilities or any combinations of these must also have a 50 m gap at least every 200 m in a north-south direction. Site services outside of exclosures must be underground or at least 4 m above ground level.

- Disturbance to wildlife and flora will be kept to a minimum. The use of tractors and other vehicles will be minimised and will avoid wildlife as far as possible. Tractors and vehicles will be used only on approved, formed tracks, unless prior approval has been obtained from the RIC.

- The maximum number of personnel living on station will be 40, except during resupply and personnel changeover, when the maximum number of personnel overnight in Zone A will be 60.

- Lighting when foggy or during darkness in Zone A will be kept to the minimum required for human safety, to reduce bird strike incidents. This will not apply to navigation lead lights, which should be left on during ship visits.

Actions

- Liaise with AAD in regard to rationalisation of the number of buildings and the space occupied by the station.

- Continue to liaise with AAD in regard to the development of a code of conduct for machinery and vehicle use to minimise impacts on wildlife and flora, and to provide for human safety.

- Liaise with AAD regarding installation of shrouding over lighting in Zone A.

- Promote and support the removal of defunct aerials and masts in Zone A.

- Liaise with AAD and other agencies in regard to minimising the use of aerials and guy wires in the reserve. Investigate methods of increasing visibility of any guy wires or masts that remain, to decrease the incidence of bird strikes.

- Survey and assess infrastructure within the station limits to identify and, where feasible and practical, ameliorate other wildlife hazards such as fences and retaining walls, which may cause injury or interference to wildlife.

- Develop educational and interpretative information about the possible sources of human impact on wildlife and place at key locations to remind all about ways of minimising human impact.

- Review procedures for storage of rubbish around the station and, as necessary, upgrade/modify procedures to ensure station wastes do not contribute to marine debris in the waters surrounding the island.

6.2.2 Zone B – Limited Access Zone

Zone B includes all of the terrestrial component of the main island and associated seastacks of Macquarie Island Nature Reserve to low-water mark, outside of Zone A (see Map 10). The marine component of the reserve is included in Zone C. Limited facilities such as walking tracks and field huts may be provided in this zone for management, scientific or educational tourism use.

In general, future development in Zone B shall be kept to a minimum and will be subject to the Activity Assessment and Approval Process of the Director (see Section 6.3). Existing facilities in Zone B include the support facilities for Zone A such as the dam and water supply from Gadget Gully and the aerials, masts and guys for communications.

Existing facilities in Zone B also include field huts, tracks, communications facilities, exclosures, markers and sites as well as facilities to carry out approved scientific experiments, data collection, communication operations and management programs. The present number and distribution of field huts (Map 4) provide adequate coverage of Macquarie Island for safety, management and scientific purposes (see Section 6.11). However, the Director may permit temporary shelters in other locations for specific purposes.

In accordance with the NPRMA, recreational use is not one of the objectives for management of nature reserves (see Section 4.7). To minimise human impacts on reserve values, recreational camping, including the overnight use of caves, will not be permitted. The Director may permit camping for authorised purposes.

Objectives – Zone B – Limited Access Zone

The objectives in Zone B are to:

- minimise the risks associated with human activity on wildlife and other natural and historic values;
- provide for approved scientific research, monitoring programs and management programs (such as alien species eradication and control, census programs, track management, hut maintenance and resupply); and
- allow tracks and huts in this zone to be used by support personnel if available.

Policies

- Limited facilities such as walking tracks and field huts may be provided in this zone to support scientific, monitoring and management programs.
- Walking tracks and associated infrastructure will be subject to the policies and prescriptions of Section 6.10.
- Any new huts, facilities, exclosures and marked sites in Zone B are to be temporary only and are to be removed at the conclusion of the project for which they were erected or as directed by the Director (see Section 6.11).
- Subject to the requirements of scientific, management and operational programs, field huts will be available for use by support personnel.
- Except in an emergency, the maximum number of people in field huts will be limited to each hut's intended capacity.
- To minimise human impact and disturbance, recreational camping, including the overnight use of caves, is not permitted.
- Servicing of infrastructure in Zone B such as communication facilities and the water supply in Gadgets Gully may be carried out as required.

Actions

- Audit and maintain a register of all developments, structures, exclosures and long-term monitoring sites in Zone B.
- In consultation with AAD, develop a maintenance schedule for infrastructure in this zone.
- Undertake track management works in accordance with Section 6.10.
- Monitor natural rehabilitation of hut sites and tracks following removal or closure.
- Clean helicopters and associated equipment, such as fuel drums, according to quarantine standards (see Section 6.6) prior to landing or entering the reserve, to reduce the risk of alien introductions.

- Promote and support the removal of fixed antennas, aerials and guy wires at field huts and their replacement with whip antennas or other appropriate facilities to reduce bird strike incidents.

6.2.3 Zone C – Marine Zone

The Marine Zone includes the state waters surrounding Macquarie Island and its outlying islets, from low-water mark to 3 nm, and the Australian waters to 12 nm that are an integral part of the World Heritage Area (WHA). The waters of the Macquarie Island Marine Park (MIMP) (see Map 3), an area of 16m ha, lie on the eastern side of the reserve and include all Australian waters from 3 nm to 200 nm, the extent of Australia's Exclusive Economic Zone (EEZ). The MIMP includes the WHA waters on the eastern side of the reserve. The WHA waters on the western side of the reserve are not part of the MIMP and therefore are not protected.

This statutory management plan can only apply to those waters to 3 nm included in the state reserve. However, in order to provide for complementary management of adjacent marine areas for all state waters, this plan adopts the strategic objectives, policies and actions for the 5.8m ha Highly Protected Zone (HPZ) (IUCN Category 1a) of the Australian MIMP Management Plan (Environment Australia 2001). This plan does provide an exception to those policies to allow authorised resupply, management operations and commercial educational tourism vessels in the waters of the reserve.

A Memorandum of Understanding has been signed between the Australian and Tasmanian Governments in regard to joint management arrangements for contiguous marine areas.

Commercial trawl fishing, primarily for Patagonian toothfish, is undertaken in Australian waters between 3 and 200 nm outside of the MIMP by a single operator and is managed by the Australian Fisheries Management Authority (AFMA) with advice from the Subantarctic Fishery Assessment Group. Some of the most heavily fished waters are within the WHA waters to the west of the reserve. Longline fishing is not permitted in the Macquarie Island Australian Fishing Zone (3 nm to 200 nm), to provide some protection to threatened albatross and giant petrel species. Stringent management controls govern fishing activity around Macquarie Island, and have included restriction to one fishing vessel and conservative catch limits. A new management plan for the Macquarie Island Toothfish Fishery was completed in early 2006.

Objectives – Zone C – Marine Zone (State Waters)

The objectives in Zone C are to protect the natural and historical values of the marine environment, namely:

- the only shallow water habitats existing in the Macquarie Island region, along with their associated flora and fauna;

- wildlife access to the island, as well as the nearshore foraging areas and nursery areas, for vast concentrations of seabirds and seals;

- its unique geological values, including those identified in the World Heritage listing;

- its contribution to the National Representative System of Marine Protected Areas (NRSMPA) as a representative sample of the Macquarie Island Biogeographic Province.

Management goals identified for the HPZ in the MIMP Management Plan (EA 2001) that apply to the state reserve waters are to:

- provide a scientific reference area for further studies of natural ecosystems, including baseline areas;
- protect threatened species, migratory and foraging marine mammals and seabirds from direct human disturbance; and
- protect pelagic species and the benthic communities from direct human disturbance.

Policies

- Australian Government ships will continue to be authorised to enter this zone for the purposes of maintenance and supply of the station on Macquarie Island and to transport authorised personnel to and from the reserve.
- No commercial or recreational fishing will be permitted in the waters of Macquarie Island Nature Reserve.
- Scientific collection of marine flora, fauna, geological specimens or cultural heritage artefacts may only be undertaken for scientific and monitoring purposes under permits and authorities issued by the Secretary, DPIW and the Director.
- Educational tourism access will be permitted where authorised by the Director.
- The use of small boats in this zone is permitted (see Sections 6.4.1 and 6.5.3).
- All practical efforts will be made to prevent impacts on the marine environment from oil spillage or fuel spillage during ship-to-shore transfer of bulk fuel (see Section 6.14).
- The practice of disposing macerated sewage and sullage into the waters of the reserve will be reviewed and recommendations for improved practices implemented as soon as practicable.
- No rubbish will be dumped in the waters of the reserve (see Section 6.13).
- Every effort will be made to minimise the risk of introduction of alien marine species by ensuring that any small boats, barges or other vessels carried on ships to the reserve are clean before entering reserve waters.
- Ballast water may not be discharged within any of the marine areas, and preferably not within Australia's EEZ around the reserve.

Further policies for the HPZ adopted from the MIMP Management Plan (EA 2001) that will apply to state waters include:

- No mining operations, including petroleum and/or mineral exploration or extraction, will be allowed.
- Passive transit of vessels through the zone will be permitted.
- Non-intrusive scientific research compatible with the strategic objectives of the MIMP will be allowed.
- In accordance with EPBCA regulations, the dumping of waste or littering in the MIMP is prohibited.

Actions

- Ensure that the crew and passengers on board all vessels within the reserve waters are aware that fishing is not permitted except under scientific permit.
- Ensure that any small boats or barges have undergone hull inspection and thorough cleaning prior to entering the waters of the reserve.
- Liaise with AAD and tourist operators to develop guidelines for anchoring and establish anchorage areas to minimise impacts on seabed.
- Liaise with the Australian and state fishing industries to ensure awareness and understanding of the objectives and policies for protected marine areas in the Macquarie Island region.
- Liaise with the Australian Government in regard to the addition of protected marine areas to the current biosphere reserve and National Estate listings.
- Where reasonably practical, record, collect and return marine debris to the station for incineration or removal from the reserve.

6.2.4 Special Management Areas

In accordance with Section 25 of the NPRMA, Macquarie Island Nature Reserve (including its surrounding waters to 3 nm) is declared a Restricted Area to which the public has no general right of access (see Section 6.2, first policy). Pursuant to Regulation 11 of the National Parks and Reserved Land Regulations 1999, a person must not enter or remain in the reserve unless the Director grants the person authority or the person is accompanied by an authorised person.

For a number of years SMAs have been designated in the reserve to further protect natural or historical values as deemed necessary by the Director, based upon qualified scientific and heritage management advice. SMAs include very sensitive areas, areas where there are high densities of breeding wildlife, and sporadic breeding colonies that are difficult to enter without disturbing endangered or threatened wildlife or causing damage to fragile vegetation. SMAs may be permanent or variable and designated for all or part of each year. Access authorisation approved by the Director are required to visit SMAs for specific research, monitoring or management purposes.

The outlying groups of Bishop and Clerk Islets and Judge and Clerk Islets are considered to be permanent SMAs. These islands have only been visited three times in the last 50 years. Helicopters were used to land shore parties in each instance: Mackenzie et al. from the US Eltanin expedition (1960); Lugg and Johnson in 1976 and Brothers et al. in 1996. Although each of these parties was small and stayed only for a few hours, it is unknown whether any disease, micro-organisms or other alien species were introduced. These islets and rocks have great intrinsic value as pristine areas. Although these islets and their wildlife are of scientific interest, the risks of adverse impacts outweigh almost any justification for visiting them.

In addition to the islets referred to above, three types of SMA are currently recognised (see Map 11).

Category 1 – Very sensitive areas

Very sensitive areas are difficult to enter without disturbing endangered and/or threatened wildlife or causing damage to fragile vegetation or other natural features. These areas are:

- the Caroline Cove region (including the southern slopes of Petrel Peak) – to reduce disturbance to wandering, grey-headed and black-browed albatrosses and giant petrels, and to avoid vegetation damage on steep slopes;
- the 'featherbed' from Handspike Point to Bauer Bay – to protect extremely vulnerable peatland vegetation, northern giant petrels, southern giant petrels and wandering albatross;
- the north end of North Head – to protect grey petrels and avoid vegetation damage; and
- Soucek and Sandell Bays on the west coast – to protect high densities of giant petrels.

The 'featherbed', a deep, quaking mire at Handspike Point, is 5000–7000 years old (see Section 3.6). Waterlogged troughs are separated by ridges dominated by *Pleurophyllum hookeri*, creating a patterned peatland. These waterlogged peats are extremely vulnerable to trampling damage. Wandering albatross and giant petrels breed in this area and are extremely vulnerable to disturbance.

Category 2

High densities of penguins make these areas difficult to access throughout the breeding season without causing significant disturbance. Giant petrels are also found throughout much of the Category 2 areas. These areas include much of the west coast and the southern part of the east coast.

Category 3

More sporadic breeding colonies of penguins and giant petrels make these areas difficult to access throughout the breeding season without causing disturbance. These management areas make up a significant proportion of the east coast of Macquarie Island.

Map 11 provides an example of the SMA map that has been in use in recent years and may be produced each year.

Objectives – Special Management Areas

The objectives of SMAs are to:

- allow for additional protection and conservation of extremely significant and/or vulnerable natural and historic values and, in particular, threatened species and their habitat;
- minimise the adverse impacts of human disturbance on breeding wildlife; and
- minimise the risk of accidental alien introduction, including micro-organisms and disease, particularly in those areas that have experienced negligible human contact.

Policies

- Specific scientific permits and/or access authorisations for research or management purposes only are required to visit SMAs during special management periods.
- The criteria used to determine SMAs for wildlife will be the species' conservation status, population numbers, breeding activity, vulnerability to human disturbance and cumulative impacts. Criteria for other sites will include historical values, vulnerability to human disturbance and other human impacts or management issues.
- Maps of the SMAs showing their locations and access conditions will be prepared annually for approval by the Macquarie Island Research Advisory Group (MIRAG) (see Section 6.7). The maps and reasons for designating the SMAs will be provided to the RIC, SL, AAD, all station personnel and visitors. The RIC will be responsible for ensuring that restrictions are enforced.
- The SMAs established by this management plan are shown in Map 11. Except for specifically authorised access, these areas are closed to access as set out below. Other areas may be added or removed as prescribed above. The access times given below are based on practice in recent years but may change in the future.
- Judge and Clerk Islets and Bishop and Clerk Islets are to be specially managed to protect their pristine environments and resident seabirds, unless compelling reasons are presented and agreed to by the Director and the Secretary, DPIW, upon the advice of MIRAG. These islets are to remain closed for the life of this plan.

Access to SMAs

Category 1 – access to these areas between 1 August and 31 May will only be granted by the Director under very exceptional circumstances. Some areas will not be able to be accessed for any reason, due to the proximity of extremely sensitive breeding wildlife.

Category 2 – access to these areas between 1 September and 30 April will only be granted by the Managing Authority under very exceptional circumstances. No routes through

breeding penguin colonies will be allowed at any time. Minimum wildlife approach distances must be observed throughout the year.

Category 3 – access to these areas between 1 October and 31 March will only be granted by the Managing Authority under very exceptional circumstances.

- Other SMAs may be designated as needed to protect giant petrels, grey petrels or other wildlife, flora, areas under rehabilitation, special ecosystems, geological/geomorphological sites, historic sites or special study sites.
- Consultation with scientists or others who may be conducting approved programs in or near SMAs will be undertaken as early as possible, to ensure minimal impacts on the SMA and on the research, management or monitoring program.
- Appropriate access routes must be designated where authorisation is given to enter SMAs.

Actions

- Prepare maps of SMAs as required each year and ensure that the RIC and the SL understand the restrictions and their roles in administering them.
- Ensure that each scientific permit holder has a copy of the SMA map and restrictions, and that copies are provided in key locations at the station to inform all personnel.
- Provide maps and brief all visitors to the reserve about the rationale for the SMAs, including helicopter pilots and small boat operators involved in resupply operations.
- Ensure that helicopter flight guidelines are compatible with SMA mapping each time helicopters are to be used.
- Liaise with scientific personnel whose programs may be affected, to identify the best times of year or areas in which to conduct their research. Encourage some research, such as geological research, to be conducted during the winter months.

6.2.5 Tourism Management Areas

One of the objectives for management of national parks in Tasmania under the NPRMA is ‘to encourage and provide for tourism, recreational use and enjoyment consistent with the conservation of the national park’s natural and cultural values’. This provision is not one of the objectives for management of nature reserves under the legislation (see Section 4.7). However, limited access for educational tourism purposes is authorised by the Director to promote appreciation, understanding and awareness of the World Heritage, biosphere reserve and National Estate values of the reserve.

There are three TMAs in the reserve, located at the Isthmus in Zone A, at Sandy Bay in Zone B, and at Lusitania Bay offshore in Zone C, respectively (see Maps 10, 13,14 and 15). These TMAs provide visitors with the opportunity to view wildlife, vegetation, geological formations, natural landscapes and historic sites. Tourist visits to the station are subject to the approval of the SL.

Proposals to extend commercial educational tourism access to other areas have not been supported, due to human safety issues, disturbance to wildlife and the infrastructure costs of providing safe access. Overnight stays in the reserve have also been suggested, entailing accommodation infrastructure or camping facilities, toilets, food supplies, rubbish disposal, first-aid capability, etc. The aim is to safely provide a significant educational experience with minimal impact on the reserve and its wildlife and flora (see Section 6.9). For these reasons, ship-based educational tourism is seen as optimal for this reserve.

Facilities currently include boardwalks, steps, viewing platforms and interpretation signs. Some of these facilities are in need of repair or replacement. Landing fees paid by the commercial tourism operators contribute to commercial educational tourism management, infrastructure and day-to-day management of the reserve.

Visits to these areas may only be undertaken in accordance with the current Guidelines for Tourist Operations and Visits to Macquarie Island Nature Reserve and World Heritage Area (Section 6.9) and in the presence of guides approved by the Director.

Objectives – Tourism Management Areas

The objectives for TMAs are to:

- provide appropriate areas of interest for educational tourism access to foster and promote awareness, understanding and appreciation of the World Heritage, National Estate, international biosphere reserve and state nature reserve values of the reserve;
- minimise the risk of introduction of alien species; and
- provide access to areas where safety risks and wildlife disturbance will be minimised as far as possible, while still meeting the previous two objectives.

Policies

- In order to comply with the NPRMA objectives for nature reserves, educational tourism access to the reserve will continue to be controlled.
- Educational tourism will continue to be ship-based for the life of this plan.
- Educational tourism will be encouraged on a limited basis for its value in promoting understanding, awareness and appreciation of the values of the reserve.
- Educational tourism will be conducted in a manner that conserves and protects the natural and cultural values of the reserve and minimises the risks of accidental introductions, undue disturbance to wildlife and adverse environmental impacts.
- The use of signs will be kept to a minimum to provide good interpretation for visitors while preserving the wilderness character of the reserve.
- Tourist visits to the station will be subject to the approval of the SL.

- The Director will review guidelines for educational tourism operators annually (see Section 6.9).

- The objectives of Zones A and B also apply to these areas.

Actions

- Replace commercial educational tourism infrastructure as necessary to meet Australian Standards, to ensure visitor safety and to ensure environmental protection.

- Investigate the need to provide further interpretation of the World Heritage values and the biogeographic values of the reserve, as well as its subantarctic affinities and relationship to New Zealand's southern islands, in literature and when guiding visitors to the reserve.

- Monitor tourist landing areas for the presence of new alien species.

Table 2 Summary of Management Zoning

Zone and Location	Value and Uses	Objectives
Zone A – Services Zone **The Isthmus**, including built infrastructure, vehicle tracks, helicopter pads and the landing beach for ship-to-shore transport (see Map 12).	The most suitable location for essential facilities and services to support scientific research and management activities. It is the site of the ANARE station (since 1948) and historically the principal location of human activity. The Isthmus is also the site of the largest concentration of elephant seals on the island. Other species, including fur seals, gentoo and rockhopper penguins breed, rest and moult in various locations within the Zone.	Zone A objectives are: to concentrate most of the human impact and activity in the reserve as far as possible in one location; to provide a site which is accessible, safe and relatively robust for human use; to minimise the impacts of station facilities, development and human activity on local wildlife; and to protect the principal breeding, moulting and resting site in the reserve for elephant seals and to protect other wildlife in the zone.
Zone B – Limited Access Zone This zone encompasses **the rest of the main island and its associated seastacks,** including Bishop and Clerk Islets and Judge and Clerk Islets (See Map 10). This zone may include SMAs and TMAs (see below).	Limited facilities such as walking tracks and field huts may be provided in this zone for management and scientific use. Boardwalks and viewing platforms may be provided in TMAs. Some areas in Zone B may be declared SMAs and closed to all visitors for certain periods, unless scientific permits and/or access authorisations are approved by the Director to visit these areas for specified research or management purposes only.	Zone B objectives are: to minimise the risks associated with human activity to wildlife, flora and other natural and historic values; to provide for approved scientific research, monitoring programs and management programs (such as alien species eradication and control, track management, hut management and resupply); and to allow provision for certain tracks and huts outside of SMAs in this zone to be used for scientific, management and operational programs.
Zone C – State Marine Waters **Low-water mark (LWM) to 3 nm** is the marine component of the Macquarie Island Nature Reserve (See Map 10).	This part of the marine zone is a no-take area that protects representative marine habitats and protects the nearshore foraging and travelling areas for the island's vast populations of seabirds and mammals. Offshore cruising at Lusitania Bay TMA to view penguin colony is permitted.	Zone C objectives are: to allow for resupply, shipping, research and educational tourism activities; to protect natural integrity; and to protect, monitor and maintain environmental features and values.

Zone and Location	Value and Uses	Objectives
3 nm to 12 nm – Australian Marine Waters **3 nm to 12 nm** is the marine component of the WHA. The eastern portion of this is included in the Australian Government Macquarie Island Marine Park (3 to 12 nm) managed in accordance with the Macquarie Island Marine Park Management Plan 2001 (see Map 3). The western waters of the WHA have no protection.	The eastern waters of the Macquarie Island Marine Park (within the HPZ) provide for protection of the foraging zone of dependent species. The western waters, even though included in the World Heritage listing, provide no protection from fishing activity.	Objectives are: to manage the marine waters of the WHA and the state nature reserve in a cooperative and complementary manner as agreed by the Australian Government and the state.
3 nm to 200 nm – Australia's EEZ. **Macquarie Island Marine Park**: One-third of the AEEZ to the east of the nature reserve is included in the park (16.2 m ha) due to its high conservation value as foraging grounds for seabirds and marine mammals. A commercial fishery operates in the EEZ to the west of the reserve. The north-eastern boundary is contiguous with New Zealand's EEZ.	The MIMP is divided into three zones: • Highly Protected Zone (5.8 m ha) • Northern Habitat/Species Management Zone (2.7 m ha) and • Southern Habitat/Species Management Zone (7.7 m ha). Further areas for protection within the EEZ may be designated in the future in the context of establishing the NRSMPA (EA 2001).	Objectives are: to encourage complementary and joint management of the adjacent protected marine areas to protect and conserve their natural and cultural values; to encourage cooperative management with New Zealand to protect and conserve the values of the adjacent protected marine areas.
Special Management Areas (SMAs) A map will be produced each year showing the SMAs with an accompanying table to explain access restrictions and the rationale behind them. Permanent SMAs include Bishop and Clerk Islets, Judge and Clerk Islets, the featherbed around Handspike Point, the southern slopes of Petrel Peak, the Caroline Cove area, Soucek Bay, Sandell Bay and North Head	These areas may be established for all or certain periods each year to provide additional protection to significant natural and historical values and, in particular, to protect breeding species and their habitat. The exact locations and restricted access periods may vary.	The objectives of SMAs are to: conserve and protect significant and/or vulnerable natural and/or historic values, in particular breeding threatened species; protect breeding wildlife and vulnerable flora from undue human disturbance; and minimise the risk of accidental introductions of alien plant species and fauna, including micro-organisms and disease, to areas that have experienced negligible human contact.

Zone and Location	Value and Uses	Objectives
Tourism Management Areas (TMAs) These areas are located in each zone at the Isthmus, Sandy Bay and offshore of Lusitania Bay.	Three TMAs are designated where tourists are permitted for the purposes of viewing wildlife, geological and historical sites. Facilities to minimise impact and disturbance include boardwalks, viewing platforms, and interpretation panels. One TMA is located at the Isthmus in Zone A, one is located at Sandy Bay in Zone B, and the third area is located offshore of Lusitania Bay in Zone C. Visits to these areas may only be undertaken in accordance with the Tourism Guidelines and in the presence of guides approved by the Director. See also http://www.parks.tas.gov.au/macquarie/guidelines.html	The objectives of TMAs are to: provide appropriate areas of interest for educational tourism access to foster and promote awareness, understanding and appreciation of the World Heritage Area, biosphere reserve, National Estate and nature reserve values of the reserve; minimise risk of accidental introduction of alien species; and provide access for visitor groups only to areas where safety risks and wildlife disturbance can be minimised as far as possible, while still meeting the previous two objectives. The objectives of Zones A, B and C also apply to these areas.

6.3 Environmental Impact and Assessment

Development on Macquarie Island can be defined as activities within Zone A (Services Zone) linked with the operation and maintenance of the station and its associated scientific research facilities; and activities in Zones B and C (Limited Access Zone and Marine Zones) relating to the maintenance of field huts, walking tracks, tourism infrastructure and activities. Scientific research activities are subject to the assessment processes and provisions of Sections 6.7 and 6.8.

Activities can range from works that change the natural or existing condition or topography of land to maintenance works on historic/heritage structures, to construction, alteration, repair or removal of tracks, buildings and other facilities or services. Major developments or activities are those that are large in scale, have high public interest or have the potential for substantial impacts on the values of the reserve. The assessment and approval process employed to reach a decision about reserve activities will vary according to the complexity and scale of the development or activity proposed.

The Tasmanian *Land Use Planning and Approvals Act 1993* (LUPAA) was amended in 2001 to include development on land reserved under the *Nature Conservation Act 2002*. However, this only applies to land that is included in a Planning Area defined by a local planning scheme or a special planning order (S. 51(1) of LUPAA). Macquarie Island Nature Reserve is specifically excluded from the Esperance Planning Scheme 1989 (clause 1.2.1). Therefore there is no requirement for development applications to be made to the planning authority, Huon Valley Council, as the council has no power to grant or

refuse a permit. Developments will still be subject to compliance with Australian Standards and the following environmental impact assessment processes.

The AAD Environmental Management System (AAD 2003) has been accredited under the requirements of the Australian/New Zealand Standard AS/NZS ISO 14001: 1996 Environmental Management Systems – Specification with Guidance for Use, and addresses all of the environmentally significant issues arising from AAD activities wherever they occur, including Macquarie Island.

Objective – Environmental Impact Assessment of Proposals

The objectives of environment impact assessment of proposals are to:

- avoid, minimise or redress the impact of proposed activities or development on the World Heritage or other reserve values (including matters protected under the EPBCA such as listed threatened or migratory species and the Australian Government marine area);
- provide an appropriate mechanism for considering new issues that have not been covered by this management plan;
- ensure that decisions related to proposed developments or activities reflect the management objectives of this plan; and
- ensure that sound processes exist for the assessment of potential impacts of proposed developments and activities.

General Policies

- All proposed activities and/or development will be consistent with this management plan and will be limited to that allowed by management zoning (see Section 6.2).
- The statutory requirements of both the Australian Government and the Tasmanian Government will apply and the environmental impact assessment for all proposals and developments will meet these requirements.
- Proposed activities and/or development in the reserve will adopt environmental ‘best practice’ methods if they are determined to be appropriate for use in the reserve.
- Proposed activities and/or developments must take into account impacts of construction, timing of work, any disturbance to wildlife or flora, source/s of material (quarantine), impacts of removals and the need for and cost of any rehabilitation measures that may be required.

Policies for Activities or Development with Minor Impacts

- Minor activities and developments included here are usually small in scale, have low public interest and low potential for impact on natural and cultural values.
- Any proposals that involve landscape modification, research, management or maintenance work involving any ground-breaking, structural disturbance, or

environmental manipulation of any kind will be assessed in accordance with the reserve activity assessment and approval procedures approved by the Director as set out in the Tasmanian Reserve Management Code of Practice (PWS et al. 2003).

Policies for Activities or Development with Significant Impacts

- Any person undertaking an activity or development will need to consider their responsibilities under state legislation.
- If there is potential for significant impact on matters protected under the EPBCA, the person proposing the activity will need to consider their responsibilities under the Act.
- If an action is to be undertaken by PWS, the Director will decide whether to refer under the EPBCA. If an action is to be undertaken by a third party, the Director will bring the requirements of the EPBCA to the attention of that party; however, the onus of whether or not to refer rests with that party. It is the *person taking the action* who has responsibilities under the Act.
- Once a referral under the EPBCA is submitted, the person taking the action will be advised (normally with 20 business days) whether or not approval is required for the proposed action.
- If approval is not required, or the proposal may proceed if undertaken in a particular manner, further action under the EPBCA is not required (unless a permit is warranted for an action to be undertaken in the Australian Government marine area). This decision will only relate to matters within the scope of the EPBCA and approvals may still be required under relevant state legislation.
- If approval is required, the next step is to determine what is an appropriate level of assessment under the EPBCA. Depending on the environmental impact assessment process to be pursued by the State, it may be that the bilateral agreement between the Australian Government and the Tasmanian Government applies, or potentially another level of assessment under the EPBCA may be appropriate (such as assessment on preliminary documentation).
- At the conclusion of the nominated process, the Australian Government Environment Minister will take a decision on whether or not approval is granted (with or without conditions). Approval conditions may include mitigation measures and/or monitoring requirements to ensure compliance with the approval (or other decision, such as a particular manner decision) under the Act.

Actions

- Undertake the appropriate assessment and approval process to ensure that impacts on natural and historical values of the reserve are avoided as far as possible.
- Ensure all applicable statutory requirements and approvals are met or obtained.
- Confirm and meet statutory requirements for planning and building approval before proceeding with new developments or activities.

- Where they apply to new activities or developments, ensure compliance with relevant Australian Standards.

- New developments will employ environmentally sustainable operating practices and use environmental 'best practice' goods and technologies.

6.4 Access to the Reserve

Macquarie Island Nature Reserve is a restricted area under s. 37 of the NPRMA. Access to the reserve requires authorisation from the Director unless a person is accompanied by an authorised person, or the person is entering the reserve in the exercise of a statutory power authorised by this management plan or in the exercise of a power under the *Nature Conservation Act 2002*. Due to the high conservation status and values of the reserve, as well as the vulnerability of the flora, fauna and soils, access to the reserve will be controlled. All visits to the reserve, whether they are for scientific, management, or educational tourism purposes, must be conducted in a manner that avoids or minimises alien introductions, adverse environmental impacts and wildlife disturbance.

The inclusion of the marine area from low-water mark to 3 nm as part of the reserve means that all vessels require the authorisation of the Director to be in the reserve. AAD vessels, tourist vessels and other visiting vessels must obtain access authorisation to enter the reserve. Occasionally, vessels will visit for emergency purposes (illness, repairs, etc.), or on speculation and be unaware that authorisation is required to enter the reserve. While access is permitted in an emergency under the International Law of the Sea, other visiting vessels will not necessarily be granted on the spot access authorisation. The RIC may allow entry to the reserve, but full reports to the Director must be made within 24 hours. Vessels in transit from New Zealand or Antarctica are also required to obtain authorisation in advance. All necessary Australian customs, quarantine and immigration clearances must be obtained.

Crew of vessels often make requests to come ashore to see the station and the wildlife. If access is authorised, the RIC will brief the crew on minimal impact behaviour, quarantine requirements and the conditions that apply to all visitors to the reserve. Permission to access the station must be authorised by the SL.

General Objectives – Access to the Reserve

The general objectives for access to the reserve are to:

- protect the natural and historical values of the reserve by controlling access to the reserve to that necessary for approved scientific or management purposes, or educational tourism*;*

- protect reserve values and visitor safety by concentrating and limiting visitor arrival points to designated locations;

- monitor and manage access by unauthorised vessels.

Policies

- Macquarie Island Nature Reserve is declared a Restricted Area by virtue of this management plan pursuant to s. 37 of the NPRMA. Pursuant to Regulation 11 of the National Parks and Reserved Land Regulations 1999, a person must not enter or remain in the reserve unless the person is granted authority or is accompanied by an authorised person.

- Access to SMAs (see Section 6.2.4) will be limited to those with specific scientific permits and access authorities approved by the Director.

- All visitors who are given authorised access to the reserve, whether AAP personnel or tourists, must be briefed on minimal impact behaviour and meet quarantine and any other requirements deemed necessary by the Director.

Actions

- In consultation with the AAD, DPIW, Quarantine Tasmania and Australian Customs, develop a protocol to be followed by the RIC and the SL in the event of a visiting vessel requesting emergency access to the reserve.

- In consultation with the AAD, develop a protocol to deal with access requests by crew and passengers of vessels visiting the reserve who have not applied for access through normal procedures (see Section 6.9).

- If access is authorised, ensure that opportunistic or emergency visitors are briefed on minimal impact behaviour and meet quarantine and any other requirements deemed necessary.

- Contact appropriate authorities and ensure that the *Antarctic Pilot* and charts show that the reserve is a restricted area and authorisation is required for visits.

6.4.1 Shipping Access

Access to the reserve is normally by ocean voyage as there are no airstrips on Macquarie Island. It is possible for helicopters to reach the reserve by island-hopping from New Zealand's subantarctic islands. The reserve has no harbours or landing facilities and all anchorages are exposed to adverse weather. The main landing site is at Landing Beach on the Isthmus, approximately 1 km south of the station on the northern end of the island. Vessels use helicopters, amphibious craft, inflatable rubber boats and occasionally barges to transport visitors and cargo to and from the main island.

The anchorages for vessels are within the marine component of the reserve (i.e. within 3 nm). The usual anchorage for AAD vessels is about 1 km offshore in Buckles Bay. During ship-to-shore transfer of fuel, the ship will come in to about 500 m from shore. Vessels may choose to anchor overnight, 'stand off', or traverse the lee side of the island throughout the night, depending on weather and sea conditions.

Navigation lead lights at the Isthmus are used when ships or boats are in the reserve. These provide orientation and are important in darkness, fog or low light conditions.

External lighting on vessels can cause disorientation in nocturnal seabirds and should be minimised to reduce bird-strike incidents.

The timing of vessels visiting Macquarie Island must be regulated to ensure that the carrying capacity of the station is not exceeded (see Section 6.2.1). It is also important to regulate the timing of any visiting vessels to avoid interference with AAD operations, particularly deployment and retrieval of scientific personnel and resupply operations.

Objective – Shipping Access

The objective is to provide safe access to the reserve for scientific research, management and operational activities.

Policies

- All vessels must anchor so that they cannot approach closer than 200 m to the shore at any point of their swing at anchor/s unless authorised to anchor closer for scientific, management or safety reasons.
- Unless required for human safety, no constructed boat-landing facilities will be provided in the reserve.
- Shipping access to the reserve will be controlled and the timing of such visits will be regulated by the Director in consultation with the AAD.
- All vessels visiting the reserve must comply with the quarantine requirements set out in Section 6.6.
- External lighting on vessels at night will be minimised to reduce bird-strike incidents. This will be a condition included on access authorities for all vessels visiting the reserve.

Actions

- Monitor and maintain records of the number of vessels and visitors to the reserve, including last and next ports of call.
- Monitor the sites used for landing during ship-to-shore operations for impacts on coastal landforms, soils, flora and fauna.
- Establish protocols for anchoring and lighting on ships in consultation with AAD and tourism operators.
- Establish a means for reporting bird-strike incidents on vessels in the reserve to the RIC.

6.4.2 Fixed Wing Aircraft Access

There are no aircraft landing grounds in the reserve. Occasionally fixed wing aircraft from New Zealand fly over the reserve when monitoring fishing activity in the New

Zealand EEZ adjacent to Australia's EEZ, or use Macquarie Island as a navigational reference point on flights to Cape Adare, Antarctica. Airdrops of supplies and equipment have occurred at Macquarie Island in the past. See Section 6.5.2 for helicopter use within the reserve.

Aircraft height guidelines are necessary to protect wildlife in the reserve during pelagic surveillance for illegal fishing activity.

Objective – Air access

The objective is to minimise disturbance to wildlife in the reserve.

Policies

- The use of fixed wing aircraft within and/or over the reserve (including the marine area to 3 nm) will require the authorisation of the Director. Aircraft flight over the reserve will be restricted to 1000 m offshore of the reserve and 1000 m over the plateau and coastal slopes or as set out in an access authority.

- Airdrops within the reserve by fixed wing aircraft will require authorisation by the Director.

Actions

- Liaise with AAD and aircraft operators in regard to height and distance requirements in the event of fixed wing aircraft overflying or visiting the reserve.

6.5 Access within the Reserve

6.5.1 Human Impact Management

Authorisations to access the reserve are designed to minimise any adverse impacts of human use of the reserve and may include special conditions in order to fulfil the objectives of this management plan. As set out in Section 6.2, the entire nature reserve, including the marine component to 3 nm, is a Restricted Area and authorisation is required to enter any part of it. Within the reserve, certain areas may be designated as SMAs with further access restrictions (see Section 6.2.4). Because some wildlife change breeding locations from year to year, the location and size of some SMAs may vary from year to year.

Human impacts in the reserve over the last 200 years have ranged from the devastating impacts of the sealing era to the relatively minimal impacts of simple monitoring and observation of wildlife. As awareness and concern about the adverse impacts of human activity has grown, environmental education programs, induction programs, minimal impact brochures and training have become increasingly important. Improvements in shipping, air and motorised vehicle transport methods and management, quarantine management, research methods, animal ethics requirements, track and field hut management, fuel supply and storage, waste management and emergency management

have all contributed to reducing human impacts in the reserve. The adoption of minimal impact codes and best practice methodology will see this trend continue into the future.

Objective – Human Impact Management

The objective is to minimise disturbance and other adverse impacts on the natural and cultural values of the reserve.

Policy

- The Director will continue to work in cooperation and consultation with all other interested parties to ensure continued improvements in environmental management and conservation practice.

Actions

- Continue to provide high-quality information, education and interpretive materials to all visitors to the reserve, which emphasise minimum impact methods and codes of conduct.
- Continue to provide environmental education and training through the use of induction programs for all visitors to the reserve.
- Ensure that environmental education and training is provided to educational tourism operators and guides to ensure that the highest standards for their visits are met.
- Remove any facilities and structures, including site markers or exclosures, that are no longer required. Clean up and/or remediation of the sites will be undertaken or organised by the responsible party with the authorisation of the Director. If structures or facilities are deemed by the Director to have historic value, then the provisions of Section 5.10 will apply.

6.5.2 Helicopter Use

Helicopters are used in the reserve for resupply operations, management and research purposes. The Director grants access authorities to the AAD for the use of helicopters within the reserve. The conditions for helicopter use are included in helicopter access authorities.

Objectives – Helicopter use

The objectives are to:

- minimise the risk of impacts on and disturbance of wildlife; and
- efficiently and effectively carry out resupply operations and deployment/retrieval of scientific, management and operational staff and equipment in the reserve.

Policies

- Except in an emergency, helicopters will require an authority to land or take off in the reserve as required by the National Parks and Reserved Land Regulations 1999.

- Except in emergencies or as deemed necessary by the Director for management programs such as eradication programs, helicopters must fly at 1000 m from the coast and 1000 m above the coastal slopes and plateau, unless otherwise authorised by the Director.

- Helicopter pilots will be authorised to use mapped flight corridors for resupply operations and transport of scientific materials and personnel. Such flight corridors are issued annually and should be reviewed for each ship visit.

- The use of helicopters to resupply the station, field huts, remove rubbish and for research will minimise disturbance to wildlife. The RIC will review the suitability of landing sites annually to ensure minimisation of disturbance to wildlife.

- A condition for the approval of tourist visits to the reserve will be that rotary-wing aircraft carried aboard tourist vessels may not be used within the reserve except for emergencies (see Appendix 8) or management purposes.

- Helicopters are not to approach within 1000 m of whales in the waters of the reserve or in Australian waters as set out in the Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines for whale viewing.

Actions

- Ensure voyage leaders, SL, RIC and helicopter pilots are fully apprised of flight restrictions.

- Ensure all helicopter pilots have flight corridor maps on board.

- Ensure all helicopter users, including scientists, are made aware of flight restrictions relating to their programs well in advance of flight operations, as compliance with environmental flight restrictions is a shared responsibility between pilot and user.

- Ensure that station resupply and field hut resupply are undertaken at a time outside of the breeding season, either early (September) or as late as possible (March or April), to minimise disturbance to wildlife.

- Encourage feedback from pilots and aircraft users for ongoing improvement of safe minimisation of environmental impact by aircraft.

- Helicopters and associated equipment, such as fuel drums, will be cleaned according to quarantine standards (see Section 6.6) prior to landing or entering the reserve, to reduce the risk of alien introductions.

6.5.3 Small Boat Use

Amphibious craft, barges, air cushion vehicles, small boats and inflatable rubber boats (IRBs) are used in ship-to-shore transfer of cargo, bulk fuel and personnel. These small vessels are also used for scientific, management and operational purposes, and for offshore cruising by educational tourism companies (see Section 6.9). IRBs also play a crucial role in response to medical and search and rescue emergencies. They are also used periodically to restock field huts with essential supplies.

Objectives – Small Boat Use

The objectives are to:

- avoid or minimise the risks of adverse impact on the environment and wildlife in the reserve; and
- minimise the risks to operators and passengers.

Policies

- All small boat operators must meet competency requirements and be aware of the following policies prior to being allowed to operate within the reserve waters.
- Small boats may be used to transport personnel and cargo for resupply operations in Zone A.
- Small boats may be used in Zone C for search and rescue and other emergencies; and for resupply, management and scientific operations in Zones A and B.
- Small boat use will be restricted to essential tasks, to minimise atmospheric emissions, wildlife disturbance and the potential for fuel spills.
- The use of small boats in Zone C for offshore viewing of wildlife by commercial educational tourism companies will be permitted as part of the tourism operator's authorisation to conduct educational tourism in the reserve.
- ANZECC guidelines for whale viewing will apply in the reserve. These guidelines limit approach distances by small boats to 100 m with no wake and to 300 m for small boats with wakes.
- If safely possible, scupper drains should be closed when arriving or leaving shore, to prevent fuel escape in the event of a fuel spill within the small boat.
- Where possible, propeller guards will be fitted on small boats to protect wildlife.
- Small boat operators must regulate their course and speed so as to minimise disturbance to wildlife and to avoid any collisions with wildlife.
- Small boat operators must adhere to cetacean approach guidelines as set out in the *Whales Protection Act 1988*.

- Small boat operators should avoid travelling through groups of seals or seabirds where possible, and may only do so at speeds below 5 knots, except when necessary for safe navigation or in an emergency.

- Small boats travelling within 100 m of the shore must not exceed 5 knots, except when necessary for safe navigation or in an emergency.

- Except when approaching or leaving authorised landing beaches, small boats are not to be used within 100 m of breeding colonies of birds or seals or, where possible, within 100 of the main entry/exit route to breeding colonies.

- Small boats, IRBs, amphibious craft, air cushion vehicles and/or aircraft may be used to carry out search and rescue work or other emergency operations without prior authorisation, but a full report of the circumstances must be forwarded to the Director at the earliest opportunity (see Section 6.16).

- Refuelling of small boats must be carried out on board the mother ship or, if it is carried out on station, refuelling must be undertaken in such a way as to minimise the risk of fuel spills.

- Motorised vessels are not permitted on any lake within the reserve.

Actions

- Continue to monitor commercial educational tourism activity at the three TMAs to determine cumulative impacts on the cultural and natural heritage values of the sites.

- Liaise with AAD and tourism operators to develop and implement guidelines for the use of small boats in the reserve that include the policies above.

6.5.4 Motorised Vehicle Access and Use

Within the Services Zone (Zone A) there are several vehicular roads and tracks used by a variety of vehicles, including amphibious vehicles, tractors, quad motorbikes, trikes, forklifts and bulldozers. As prescribed in Section 6.2.1, a code of conduct for the use of motorised vehicles in Zone A should be developed to minimise impacts on wildlife and vegetation and for human safety.

Objectives – Vehicle Access

The objective for vehicle access and use is to minimise their impacts on the Isthmus and its wildlife and vegetation at all times, but particularly during breeding and moulting periods.

Policies

- Motorised vehicles are to be used only in Zone A on established roads (see Map 12) for work purposes only.

- Access by motorised vehicle to Gadgets Gully in Zone B for maintenance of the station water supply system will be permitted. Disturbance to wildlife and vegetation by motorised vehicle use must be minimised as far as possible.

- Roads and tracks may be closed to prevent disturbance to breeding wildlife or to protect other natural or historic values.

- Approval and advice from the Director regarding the use of local materials for track maintenance and resurfacing will be required (see Section 6.3).

- The construction of any new vehicle tracks or alterations to existing tracks will require prior approval of the Director as set out in Section 6.3.

Actions

- Liaise with AAD to develop a code of conduct for the use of motorised vehicles in the reserve.

- Liaise with AAD to ensure consistency between the AAD Small Boats Manual and this management plan in regard to small boat use in the reserve.

- Monitor the use of vehicles in Zone A, and restrict their use if necessary to minimise disturbance to breeding and moulting wildlife.

6.6 Quarantine Management

The aim of quarantine management for the reserve is to minimise the risk of accidental introduction of alien species. Alien species are any organisms introduced directly or indirectly to the reserve by human activities. Alien species pose the greatest threat to the integrity of natural ecosystems in the reserve. While fewer alien species have become established in Macquarie Island Nature Reserve than on most other subantarctic islands, some of these aliens have had and continue to have major long-term impacts on the flora and fauna of the reserve (see S. 3.11, 5.7 and 5.9). Some of these impacts are likely to be irreversible, and the removal of established alien species is expensive and difficult, if not currently impossible. Prevention of the establishment of further alien species is by far the most cost-effective means of management. Warmer temperatures resulting from global climate change are likely to increase the risk and impact of introductions due to more favourable survival conditions. From both ecological and management points of view it is imperative that every effort is made to prevent any further alien introductions.

The AAD has implemented a range of initiatives and procedures at the AAD stores and on the wharf for minimising this risk. The AAD, PWS and DPIW are working together with Quarantine Tasmania to establish clear quarantine protocols for all shipping to and from Macquarie Island, including protocols for unauthorised visits to the reserve by yachts, fishing vessels and emergency landings. A person at the station is formally appointed by Quarantine Tasmania as a quarantine officer.

The greatest risk to the reserve is posed by alien species arriving at Macquarie Island in the shoes, clothing, equipment and cargo of personnel and tourists, particularly those who

have visited other subantarctic islands, or other parts of the world with similar climatic conditions. The use of tourist ships and fishing vessels to transport AAP personnel to the reserve is also of concern. The introduction of brown rats to Macquarie Island could have serious impacts on the reserve.

Although less likely, there is also a quarantine risk of introduction of alien species to mainland Tasmania by vessels that have visited Macquarie Island. Therefore, care must be taken to ensure that quarantine and alien species prevention measures meet state regulations and are undertaken by people entering mainland Tasmania from Macquarie Island. Quarantine Tasmania is the delegated authority under the Australian *Quarantine Act 1908* to act for the Australian Quarantine and Inspection Service.

As a part of Tasmania, Macquarie Island is declared a Control Area under the Tasmanian *Plant Quarantine Act 1997*, which means that there are import requirements for plants, animals, personnel, cargo, equipment, tourist vessels, etc. returning to Tasmania from Macquarie Island.

Hydroponic cultivation of a limited range of vegetables and herbs under strict conditions provides a source of fresh food for personnel on-station. Hydroponics reduces the need to transport fresh produce to the reserve, thereby reducing the risk of introducing alien invertebrates, fungi, scale and soil.

Objectives – Quarantine Management

The objectives of quarantine management are to:

- prevent introduction of alien plant species and fauna (and plant and animal pathogens) into the reserve; and
- protect the reserve from the adverse impacts of alien introductions.

Policies

- The Director requires that all materials, equipment, transport (vehicles, vessels, and helicopters) and foodstuffs, whether for scientific, management, tourism or personal use, be suitably cleaned and/or fumigated before entering the reserve.
- The Director will liaise with AAD with respect to the development and implementation by AAD of procedures to prevent and/or control the establishment of any alien species imported into the reserve due to AAD activities.
- The Director may require evidence of hull anti-fouling as a condition of access authorisation of access to the reserve.
- The Director requires that any vessel visiting the reserve has been certified free of rodents since its last major port of call, and that stringent precautions have been taken to ensure that no re-infestation has occurred since certification.
- No wharves or mooring facilities will be constructed in the reserve. Direct mooring to the land will be prohibited except for authorised purposes.

- Vessels must be anchored at least 200 m (at point of closest swing at anchor) from the coast except where written permission is given by the Director to anchor closer for scientific, management or safety reasons. Such authorisation will be only for daylight hours.

- Cleaning, scrubbing and/or removal of marine growth of the hulls of small boats will be undertaken and boats will be inspected for cleanliness by quarantine officers before entering the reserve.

- Ship ballast water management must comply with international regulations. The RIC should advise visiting vessels that ballast water cannot be discharged within 12 nm of the reserve and, if at all possible, should not be discharged within 200 nm (the AEEZ).

- All visitors must thoroughly clean all belongings and equipment before arrival at Macquarie Island. Particular care should be taken to clean seeds and propagules from equipment and camera tripod feet, equipment cases, carry bags, velcro fastenings, gloves, socks, gaiters and athletic and outdoor footwear.

- No fresh food or plant material will be taken ashore or in authorised airdrops, other than as approved and inspected cargo.

- Vegetable and herb seeds proposed for hydroponic cultivation will be cleared with Quarantine Tasmania before transport to Macquarie Island. The lists of species to be cultivated are provided to AAD by PWS upon the advice of DPIW.

- Waste foodstuffs, plants or plant material which may germinate or sprout (including vegetables and herbs for hydroponics) must be incinerated, removed from the reserve or disposed of in a way previously approved by the Director which will ensure that they cannot grow in the reserve.

- No poultry products or brassica waste may be disposed of into the waters of the reserve.

- No poultry products (except pasteurised whole egg powder) can be taken to field huts. This is to minimise the risk of the spread of disease to bird life.

- Fresh fruit and vegetables may not be taken to field huts.

- Poultry waste and eggshells at the station will be burned.

Actions

- Identify, clean and/or remove likely contamination points where species may adhere to vessels, cargo and people and be transported to the island.

- Participate in reviews of quarantine procedures with AAD, DPIW, Quarantine Tasmania and Australian Quarantine and Inspection Service.

- Representatives from PWS and DPIW will continue participation on the AAD Environment Committee as necessary.

- Ensure that induction and education programs for all visitors to the reserve continue to emphasise the risks and impacts of alien introductions and the precautions that must be taken to minimise these risks.

- Ensure that educational material regarding quarantine gets to visitors before they pack to go to the reserve and to family and friends who may send items to people on the reserve.

6.7 Macquarie Island Research Advisory Group

Monitoring, data collection and scientific research programs are conducted in the reserve by many organisations and individuals, and a scientific permit is required from the Secretary, DPIW to conduct these programs in the reserve (see Section 6.8) under an access authority granted by the Director. In 2002, the Macquarie Island Research Assessment Group (MIRAG) replaced the Macquarie Island Advisory Committee established in the 1960s. The membership is nominated by the Director and the Secretary, DPIW, and currently consists of operational management, planning, conservation and scientific specialists from PWS and DPIW. The role of MIRAG is to assess applications for scientific permits for research for compliance with the *Nature Conservation Act 2002* and for compliance with this management plan. MIRAG then provides advice and recommendations to the Secretary, DPIW, regarding the issuing of those permits and any conditions required, as well as advice to the Director on the granting of access authorities and any conditions required. The scientific research application assessment process is described in Section 6.8.

Objectives – MIRAG

The objectives are to:

- provide advice and recommendations to the Secretary, DPIW, and to the Director on the issuing of scientific permits and access authorities, respectively;

- ensure the conditions of permits are consistent with this plan; and

- provide advice on conservation management projects in the reserve.

Policies

- MIRAG will be maintained as a multi-disciplinary review committee to advise the Secretary, DPIW, the Director, AAD and Antarctic Science Program Leaders on the proposals for scientific research and monitoring programs to be conducted in the reserve.

- MIRAG may include scientific representatives from AAD and other relevant research organisations.

- MIRAG will advise upon and assess all scientific research proposals, conservation management projects and monitoring activities in terms of their compliance with the

Nature Conservation Act 2002 and the objectives of this management plan, having particular regard to the overall impact of such activities on the values of the reserve.

Actions

- In considering research applications and providing advice to the Secretary and the Director, MIRAG will:
  - take into account any relevant information relating to previous research;
  - in the case of ongoing research programs, review compliance with the previous year's permit;
  - review access restrictions and impacts on any SMAs (see Section 6.2.4); and
  - consider the overall impacts on natural and historical values and the cumulative effects of research activities over time.
- During initial discussions, encourage applicants to work cooperatively, where possible, to minimise impacts on the reserve.
- Encourage applicants to link their proposed research to the management objectives of this plan.
- Encourage applicants and scientists running long-term monitoring programs to link with other regional or international programs when possible, in order to maximise the value of the research or monitoring program.

6.8 Research and Educational Use

Macquarie Island Nature Reserve is one of the most valued and valuable conservation reserves in Australia and the world. As such, any scientific research or management activity must reflect the conservation status of the reserve. The Macquarie Island WHA, listed for its geoheritage and aesthetic values, includes the island and surrounding waters out to 12 nm. The reserve is also a UNESCO Biosphere Reserve, it is listed on the Register of the National Estate, and a nomination for listing as a Ramsar Wetland of International Significance is in preparation. Several of the native vertebrate species in the reserve, as well as their habitat, are listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999*, and/or the *Tasmanian Threatened Species Protection Act 1995*. Several of these species and their habitats are the focus of long-term recovery plans and scientific research programs.

Other major research occurs in two important areas: geoscience studies and climate change studies. The recognition of Macquarie Island as a World Heritage area reflects the value the international scientific community places upon the reserve's geology. Study of Macquarie Island's ophiolite complex (earth mantle and sea floor rock sequences) is providing valuable insight into the Earth's formation, structure and continuing tectonic processes.

Climate change studies focus on both the recording of meteorological and upper atmospheric data and the impact of climate change on terrestrial ecosystems. Macquarie Island has the longest record of meteorological observations for the Southern Ocean region and, because of the scarcity of land south of Australia and New Zealand, provides vital data for global weather predictions and climate modelling. Macquarie Island is a key site for international polar climate change research.

The Research and Monitoring Plan for the Macquarie Island Marine Park is currently under review by Department of Environment and Heritage (DEH). DPIW and Department of Tourism, Arts and the Environment (DTAE) should contribute to this review to ensure that research and monitoring programs are coordinated and cooperative. This will enable a strategic approach in the identification of broader ecosystem indicators and monitoring of broader subantarctic ecosystem health.

The impacts of commercial fishing activities in adjacent waters on the reserve's natural and cultural values should be a research priority. Trophic interactions and direct impacts could have an effect on the biodiversity of the reserve and its threatened species in particular.

Monitoring the long-term effects of alien species on native flora and fauna as well as on the landforms of the island is also undertaken (eg. rabbits occupy bird-breeding burrows and modify the vegetation to the extent that erosion and landslips result).

All research undertaken in the reserve requires a scientific permit as well as an access authority (see Section 6.4). The reserve is one of the most researched sites in Australia. The provisions of this plan seek to take advantage of the extensive baseline information for the progression of earth system understanding. The Macquarie Island Citation Database (http://www.DPIW.tas.gov.au/library/Macquarie.htm) lists over 1300 refereed scientific papers, published and unpublished reports and theses as of December 2002.

All Australian Antarctic Science applications are assessed by MIRAG in the first instance (see Section 6.7), and then again by MIRAG following assessment by the Antarctic Research Assessment Committees and Antarctic Animal Ethics Committee if vertebrate fauna are involved (as well as university ethics committees when applicable). Public interest in and public scrutiny of research programs in the reserve, particularly those involving threatened animal species, is high. The approval process allows for this interest by providing details of vertebrate fauna research proposals on the web (http://www.DPIW.tas.gov.au/inter.nsf/WebPages/SJON-55E3X3?open#top) and invites public comments within a specified period. The Secretary is obliged to consider these comments in determining whether a permit should be issued and whether any conditions should be imposed on that permit (DPIWE 2003b).

Any research conducted on living resources in the marine environment requires a permit under the *Living Marine Resources Management Act 1995* approved by the Minister or his delegate.

Research Priorities

Any research conducted in the reserve must be undertaken in the context of the reserve's nature conservation values and their significance, IUCN Category 1a values given by its

World Heritage listing or values representing the global scientific community. Research should contribute to understanding the evolution of the island and the ecological processes in the reserve in both a local and global context as well as the effects of human influences in and adjacent to the reserve. In line with its role as a biosphere reserve, the strategic importance of Macquarie Island for global monitoring and pure research for understanding global processes is also recognised; however, priority is given by MIRAG to research programs that will contribute significantly to effective management and conservation of the reserve. The Director will seek the advice of the Secretary in regard to the cumulative impacts of research on the reserve.

AAD provides the overall coordination and logistic support for research and management programs in the reserve. Research is carried out on Macquarie Island under the auspices of the Australian Antarctic Program AAP, administered by AAD out of Hobart. AAD provides transport and logistic support, maintains the field huts and the research station on the Isthmus, and conducts and manages scientific research programs both on land and in the Southern Ocean. Recently some transport to the reserve for scientists has been provided by tourist ships, but all other support is provided by AAD. The Australian Government ensures that all research programs conducted in the reserve meet the same criteria and standards as AAP programs carried out in Antarctica.

The State of Tasmania is now taking a more active role in the management of human activities and research in the reserve due to its international and national obligations for WHA management. This is also due to the state's legal obligations for threatened species under both Tasmanian and Australian legislation (see Section 2).

Due to recent changes in Antarctic research priorities, AAD will be reducing its support of research at Macquarie Island, beginning in the 2003–2004 season. The AAD may send only one vessel to the reserve each year for the foreseeable future. The Director and the Secretary will need to consider the impacts of such a reduction in support for management and research programs and seek alternative logistic and transport support. In the event that AAD withdraws its support altogether, consideration will need to be given to the future of human use of Macquarie Island and this management plan will need to be reviewed in light of such circumstances.

The Subantarctic Plant House at the Royal Tasmanian Botanical Gardens (RTBG) provides a valuable off-reserve resource for research in relation to species cultivation, morphology and climate change monitoring. Off-reserve research should be encouraged where possible to minimise impact on the reserve and its wildlife.

Educational Use

One of the management objectives for nature reserves is to encourage education based on the purposes of reservation and the natural or cultural values of the nature reserve, or both (see Section 4.7). Many of the research programs undertaken in the reserve have been carried out by postgraduate students under the supervision of chief investigators whose programs have been assessed and approved as outlined above. The Institute of Antarctic and Southern Ocean Studies at the University of Tasmania is interested in running accredited courses at Macquarie Island. Educational programs will need to be developed in full consultation with all stakeholders and any participants would be subject to all of

the same access conditions and research permit processes as any other program in the reserve.

Commercial educational tourism (see Section 6.9) under certain conditions has been allowed due to its educational value.

Objectives – Research and Educational Use

The objectives of scientific research, education, long-term monitoring and conservation management programs in the reserve are to:

- enhance our knowledge of the World Heritage, natural and historical values of the reserve, particularly where this understanding will contribute to the protection, conservation and future management of these values; and

- enhance the identification and understanding of global climate change, natural processes and/or human use induced changes, particularly those that will significantly contribute to the conservation of species that exist in the reserve, by undertaking or contributing to national, regional and global studies and monitoring programs.

Policies

- Under the *Nature Conservation Act 2002*, all scientific research, long-term monitoring and conservation management programs undertaken in the reserve must be approved by the Secretary, DPIW. The Director authorises any access to the reserve required to undertake these programs.

- Any research conducted on living resources in the marine environment will require a permit under the *Living Marine Resources Management Act 1995* approved by the Minister or his delegate.

- Research and monitoring programs in the marine environment will be consistent with the Research and Monitoring Plan developed by DEH.

- In the event of an emergency in the reserve, such as a disease outbreak or deaths of large numbers of animals, a protocol will be established to allow emergency scientific permits to be issued (see Section 6.16).

- The duration of research permits is 12 months. Long-term programs will be reviewed annually, enabling the Secretary and the Director to modify conditions on permits and access if considered necessary. For long-term/ongoing programs all reporting requirements of a permit must be met before any further permits and subsequent access to the reserve by those individuals are issued.

- Breaches of permit conditions may attract penalties and affect the issue of further permits.

- For long-term programs, the Secretary and the Director will require interim reporting of research results where these results are important for ongoing conservation management programs, particularly for threatened species.

- Unless otherwise specified in the permit, all chief investigators will provide the Secretary with three copies of all scientific papers and one copy of any thesis produced as a result of the research. The chief investigator and the Secretary will agree upon the timing and confidentiality of reports. If the reports are not confidential, then one of the required three copies, and a copy of all theses, must be lodged in the Environment Library.

- The Secretary will ensure all reports, papers and theses are listed on the Macquarie Island Citation Database.

- All scientific research, monitoring and conservation management activities must minimise their impact on the reserve's geology/geomorphology, flora and fauna species studied and their habitat, as well as minimise impact on non-target species, communities and ecosystems.

- In approving research proposals, monitoring programs and conservation management projects, the Secretary and the Director must consider the combined and cumulative impacts of all concurrent programs.

- All geoscientific research on rare, sensitive or restricted geological types, features and outcrops must be conducted with extreme care and strong justification for the work. Such research will be closely monitored by MIRAG and cumulative impacts on those features and outcrops as well as surrounding vegetation and wildlife will be considered in project assessments. Limits will be placed on the amount of material to be removed and the methods used to remove rock from the field. Limits will be enforced.

- All scientific research, monitoring, conservation and management activities involving threatened species must clearly demonstrate significant contribution to the long-term conservation, management and protection of those species and must meet the current guidelines for threatened species research.

- Research reports must include an explanation of how the research can be used for long-term conservation, management and protection or enhancement of global scientific understanding.

- Flora, fauna, geological specimens or cultural heritage artefacts may only be collected in the reserve under a permit issued by the Secretary, DPIW, and removed from the reserve with the authority of the Director. Permit conditions for the collection of flora and fauna will include the requirement to lodge type material for any new species with the Tasmanian Museum and Art Gallery (TMAG). If any material remains at the conclusion of research and is no longer required for research purposes, TMAG has the right of first option to retain any material of significance to the state.

- Any such material collected in the reserve that is not retained by TMAG is to be made available for curation in the first instance to the appropriate institution in the state of Tasmania, and in the second instance, to a recognised interstate or international institution approved by the Director. The material must be available for study purposes when required by the Director. No material may be removed from the reserve for private collection or for profit.

- Collection of material from the reserve will be minimised through the encouragement and facilitation of cooperative research. Prior to authorisation being given for the collection of any new material, researchers must demonstrate that previous research and collections cannot be used. The state will develop and maintain a database of collections to assist researchers.

- Regional and global scientific research and monitoring programs must clearly demonstrate their contribution to the understanding of global processes and change.

- Research and monitoring programs may only be undertaken in the reserve if they meet the above conditions and cannot be reasonably undertaken elsewhere. This must be clearly justified in research and monitoring proposals.

- Experimental sites may be set up within Zone A, Zone B and Zone C with prior written approval of the Director. The person/s supervising such experiments will be responsible for notification of the site location to the Site Register custodian, maintenance of the site to a standard approved by the Director, and restoration of the site to as near as possible its natural state on termination of the programs to a standard approved by the Director. If, in the opinion of the Director, the site cannot be restored to this standard, then the activity will not be permitted.

- Any higher educational programs conducted in the reserve will be subject to all of the conditions for research given above and any other conditions the Director may consider necessary to protect the values of the reserve and the integrity of other research, monitoring and management programs conducted in the reserve.

Actions

- Liaise with DPIW in regard to guidelines and criteria for assessment, prioritisation, monitoring and evaluation of research to be conducted in the reserve based on the research and management priorities identified in Table 3.

- Encourage cooperative research between nations, research institutions, management agencies and disciplines, both in the reserve and with studies undertaken outside the reserve, to consolidate knowledge and understanding and to minimise the impacts of research on the reserve.

- Liaise and consult with DEH in its review of the Research and Monitoring Plan for the Macquarie Island Marine Park.

- Encourage international and national research programs that directly contribute to conservation outcomes specified in recovery plans for threatened species.

- Assess all research, monitoring, conservation and management proposals against this management plan and the Conservation Strategy.

- Ensure that qualified and experienced personnel are directly in charge of field operations and that inexperienced/trainee personnel are adequately trained and supervised.

- Ensure that research methods and invasive techniques (including attachment of equipment and marking) are 'best practice' to minimise impacts on wildlife.
- Encourage research into methods to minimise the risk of further introductions of alien biota.
- Require research, monitoring, conservation and management activities to be conducted in such a way as to:
  - ensure protection of the natural and historical values of the reserve;
  - avoid or at least minimise damage to geological or geomorphological features, or sites of geoconservation significance;
  - avoid/minimise impacts on threatened species;
  - avoid/minimise risk of alien introductions;
  - ensure no irreversible damage to native flora and fauna, communities or ecosystems; and
  - minimise interference with essential management operations.
- Maintain a scientific and monitoring site register and any markers associated with them. Remove any redundant or abandoned markers or exclosures after all efforts have been made to locate original researchers or others who may have information regarding their origins and an informed assessment of their research value has been made. Detailed photographs must be taken and GPS locations or grid references must be recorded as accurately as possible. A detailed written description of the site and markers including the materials from which they have been constructed must also be made. Minimise the use of site markers. Research proposals must identify the number of sites, the general locations/habitats of marked sites, the length of time they will be retained and any maintenance required. Authorisation must be granted prior to installation.
- Maintain the Macquarie Island Citation Database.
- Develop and maintain a database of scientific collections.

Table 3 – Research Priorities (not in priority order)

Long-term monitoring	• Monitor threatened animal species numbers, distribution, population trends and critical habitats. • Monitor impact of global climate change on natural ecological processes and ecosystems. • Encourage and support programs that provide input to national and international conservation initiatives. • Conduct programs of international significance with conservation outcomes specific to Macquarie Island WHA. • Monitor impacts of alien species on natural ecological processes and ecosystems. • Monitor re-establishment and recovery of native species following alien species eradication. • Where information is lacking, obtain population numbers and trends of native species.
Threatened species	• Undertake research and monitoring to contribute to development of conservation and recovery strategies. • Implement complementary programs with international initiatives. • Encourage/support programs that provide input to national and international conservation initiatives (e.g. CCAMLR). • Ensure all work on threatened species is consistent with approved Recovery or Threat Abatement Plans. • Monitor changes in the degree to which anthropogenic threats affect threatened species in the reserve, including interactions with legal and illegal fisheries, marine pollution, disease outbreaks or direct disturbance.
Geology and geomorphology	• Understand the geological and geomorphological processes that led to the formation of the reserve. • Apply that knowledge to understanding global earth processes. • Research unique attributes of the reserve that contributed to WHA listing/values. • Research the impacts of geoscientific research on the reserve and how these impacts can be avoided or minimised.
Marine baseline studies and monitoring	• Quantitative baseline biological assessment of the coastal waters to be used to detect changes in community structure of coastal ecosystems. • Long-term quantitative monitoring to provide information in the event of an oil spill or similar accident, understanding of the coastal ecology of the reserve.
Educational tourism impact studies	• Undertake long-term monitoring of human impacts on wildlife, historic sites and natural environment at tourist management areas. • Monitor numbers, timing and duration of visits. • Monitor for any alien species. • Review visitor management/behaviour strategies (e.g. wildlife approach distances).
Human impact studies	• Monitor human impacts due to conduct of research programs. • Monitor impacts of human occupation at the station and field huts – human waste, grey water, rubbish, etc. • Monitor impacts on the environment associated with commercial educational tourism activities. • Investigate the cumulative impacts of research programs on threatened species or species that are vulnerable to human disturbance, and their habitats.

6.9 Educational Tourism Management

Commercial educational tourist ships have been visiting Macquarie Island sporadically since 1970. Subantarctic and Antarctic tourism have become viable industries since the late 1980s, with the majority of tourism operations occurring in the Antarctic Peninsula region due to its short sailing distance from South America. Tourist ships have visited Macquarie Island every year since 1992 (see Table 4) and are expected to continue to visit. As public interest in the subantarctic grows, further commercial interest in developing subantarctic tourism, particularly between Tasmania's and New Zealand's subantarctic islands, is expected to increase in the future.

Tourism, films, photographs and other media are extremely important in raising public awareness and appreciation of reserves, contributing to ongoing government support for reserves with high conservation values. Collections and exhibits in museums and other off-reserve facilities, such as that provided by the Subantarctic Plant House at the RTBG, are important research and educational tools for scientists, historians and the public. Tourism to Macquarie Island is supported by the Tasmanian Government partly due to its contribution to Tasmania's desire to become a centre for Antarctic tourism, shipping, resupply and other services to the international Antarctic community.

The risk of accidental introduction of alien species, particularly pathogens, is the greatest threat from commercial educational tourism, as well as disturbance to wildlife and the environment in general. Monitoring of two tourist visits in 2003 indicated that giant petrels are sensitive to human activity and particularly to small boat operations (Holmes et al., unpublished report). However, human activities and small boat operations associated with research and reserve management programs are common occurrences, particularly during the summer months. These risks must be kept to a minimum and that is achieved through induction programs, educational material and quarantine measures; limiting the time allowed in the reserve, the number of sites visited and the frequency of visits; limiting the number of visitors, their group sizes and activities; and monitoring sites.

PWS guidelines for tourism operations and visits to the reserve are well established and accepted by the international tourism industry. In essence, they allow for controlled commercial educational tourism to three sites in the reserve (see Section 6.2.5 and Maps 10, 13, 14 and 15), under the supervision of authorised officers of the PWS with assistance from trained AAP volunteers. Landing fees for commercial visits have paid in part for staff, tourism infrastructure to ensure safety and the minimisation of disturbance to wildlife, and other management programs to benefit the reserve. These fees also fund a package of information and a booklet, *Macquarie Island*, which are provided to visitors on embarkation for the voyage. The package includes brochures on its World Heritage geological values, history and cultural heritage values, scientific programs, threatened species, flora and fauna, as well as minimum impact and quarantine precautions.

Since tourism management policies were developed in 1989, tourist numbers have varied between zero (1991–92) and 559 (1990–91) people in a season in the last 12 years (see Table 4). The guidelines currently set a maximum number of 750 tourists per season; however, this limit can be changed. Currently, tourists are not allowed to stay overnight on the island and toilets are not provided, although visitors may use station facilities at the SLs' discretion.

Table 4 Macquarie Island Tourist Visits 1987 – 2002

Summer Season	Approved Ship Visits	Actual Ship Visits	Approved pax landings	Actual pax landings	% less than expected
1987–1988	1	1		18	
1988–1989	0	0		0	
1989–1990	0	0		0	
1990–1991	4	4		559	
1991–1992	0	0		0	
1992–1993	4	4		416	
1993–1994	4	3		128	
1994–1995	5	5	432	342	20%
1995–1996	9	8	421	351	18%
1996–1997	6	6	526	490	7%
1997–1998	6	6	376	313	17%
1998–1999	6	6	458	374	20%
1999–2000	7	4	558	329	40%
2000–2001	9	7	818	556	32%
2001–2002	8	7	522	371	40%
Average					31%

Source: PWS

Tourism and recreational use are not objectives of management for nature reserves (see Section 4.7); however, educational tourism fits with the objective of managing the reserve for educational purposes. There are benefits from educational tourism in promoting support for conservation of the reserve and its values.

Due to existing levels of infrastructure and the constraints given above, proposals to extend commercial educational tourism access have not been supported as they would raise infrastructure requirements, increase wildlife disturbance and likely create human safety issues. Extension of the Sandy Bay TMA to include access to the plateau is undesirable due to dangerous weather, the risks involved in search and rescue on the plateau, and the high cost of infrastructure required to protect the environment. Wireless Hill, the site of Mawson's radio station on North Head above the station, is even more exposed and the track is very steep. Visits to the confined rocky areas around Garden Cove to see rockhopper penguins and fur seals are not permitted because of safety risks, and because previous visits resulted in too much disturbance to wildlife.

In 2003, the criteria used to select educational tourism operators included the following:

1) benefits to the state of Tasmania (e.g. employing Tasmanians or re-supplying in Tasmania);

2) benefits to the management and protection of Macquarie Island Nature Reserve (e.g. assistance with programs, or with transport of equipment and personnel);

3) minimisation of environmental impacts both offshore and on land, based on the environmental impact statement submitted with the application;

4) adherence to strict safety guidelines, including a degree of self-reliance in such matters;

5) clear communication to the company's clients, crew and staff of appropriate messages about the natural and cultural values of the island, including the role that visitors play in protecting those values;

6) forms of tourist operator accreditation and relevant qualifications held by the company and its regular staff members;

7) flexibility of operating timetables (for instance if weather or AAD shipping changes caused delays); and

8) past performance in this or related operations.

Objectives – Educational Tourism Management

The objectives for educational tourism management are to:

- ensure continued public support for conservation, scientific and management efforts in the reserve;
- ensure minimal impact from commercial educational tourism activities on the natural and cultural values of the reserve;
- provide benefits to the state in its role as a centre for Antarctic tourism and support activities; and
- allow quality experiences of the reserve's natural and historical values while minimising potential risks and impacts.

Policies

- The Guidelines for Tourist Operations and Visits to Macquarie Island Nature Reserve and World Heritage Area (http://www.parks.tas.gov.au/macquarie/guidelines.html) will provide the policy framework for commercial educational tourist visits to the reserve.
- Multi-year approvals may be given to operators who continue to meet all standards and requirements for visits to the reserve.

- Proposals to extend educational tourism activities in the reserve will be considered on their merits and their ability to meet the provisions of this management plan, minimal impact requirements, safety requirements and any other criteria deemed necessary by the Director and set out in the Guidelines for Tourist Operations and Visits to Macquarie Island Nature Reserve and World Heritage Area.

Actions

- Continue to monitor educational tourism activity at the three TMAs to determine cumulative impacts on the cultural and natural heritage values of the sites.
- Review the educational tourism guidelines for the reserve as necessary when new knowledge or changes in circumstance warrant.
- Ensure these guidelines are implemented to minimise impacts of educational tourism on the natural and cultural values of the reserve.
- Continue to support educational tourism in the reserve and to promote the reserve as an educational tourism destination.
- Continue to provide educational and interpretive materials for visitors to increase their knowledge, understanding and appreciation of the reserve's natural and historical values.
- Develop cooperative and complementary educational tourism guidelines, quarantine and tourism management practices where tourist vessels visit other subantarctic or similar environments prior to arrival at Macquarie Island.

6.10 Walking Track Management

Over the last 50 years, tracks have developed in the reserve as a result of travel to certain areas for research or monitoring projects, or for recreational use. Travel anywhere in the reserve was considered acceptable, albeit risky, until recent years, when impacts on the natural and cultural values of the reserve, and in particular on the breeding success of threatened species, became noticeable. The risk of hypothermia and/or injury due to the weather and terrain of Macquarie Island has also contributed to an increased awareness of the need for safe travel and work practices in the reserve.

The management strategy for walking tracks on Macquarie Island (Dixon 2001) was prepared for PWS in recognition of the need for a comprehensive and critical assessment of the track network on the island. The strategy considered issues such as current use, occupational health and safety, environmental protection, long-term track stability and wildlife disturbance. A complete inventory was compiled and priorities were established for works, re-routing or closure of tracks, new tracks and monitoring needs.

Over 150 km of walking tracks and access corridors have developed on the island over the years as a result of scientific research, management programs and recreational use. Australian Standard 2156 provides a classification system for walking tracks. The formal track network includes the Overland Track (31.7 km) and the tracks to the field huts on

the island. The total length of these tracks is 73 km. Other minor tracks have a total length of 19 km and access less visited or more restricted areas. There are also several access routes and closed tracks on the island, as well as some boardwalk sections, such as those at Green Gorge and above Gadget Gully. High usage of a number of tracks has resulted in considerable localised damage, particularly on steep slopes, such as those on North Head.

There are an additional 290m of boardwalk, steps and viewing platforms constructed specifically for commercial tourist ship visits, although personnel on the island use them as well. The 75 m boardwalk and viewing platform to the king penguin colony at Sandy Bay was removed in 2002 because it was impinging on the growth of the colony. Viewing of the breeding colony from the beach at recommended distances is allowed.

The strategy details an approach to stabilising or ameliorating active or unacceptable impacts using a prioritised program of works as well as track realignments, closures and other management actions. The strategy also recommends user education and seasonal management actions for specific tracks or access corridors.

Objective – Walking Track Management

The objective of walking track management is to minimise, ameliorate and stabilise impacts of walking and trampling in the reserve.

Policies

- The Management Strategy for Walking Tracks and Access Corridors in Macquarie Island Nature Reserve (Dixon 2001) will be the guiding document for prioritisation and implementation of all track work on the island.
- Track management and maintenance is the responsibility of PWS management staff in the reserve and/or personnel appointed by PWS for this task.
- All track work, including realignments, track marking and other minor works will be undertaken by PWS staff or personnel appointed by PWS. Other people may be asked to assist under direction from PWS if appropriate.

Actions

- Undertake the track management works in accordance with the priorities indicated in Dixon (2001) as follows:
  - Highest priority works are those required to meet Australian Standards for occupational health and safety and for tourist access.
  - Progressively replace all wooden track markers and directional signs on the Class 5 track network with more robust and low maintenance markers.
  - Ensure that Class 6 tracks and closed tracks are removed from general maps as prescribed in the strategy. Class 6 tracks may be shown on maps used for authorised access by scientific and management personnel.

– Ensure that induction training, field training and environmental education issues are covered in a consistent manner between PWS staff and AAD staff, and that minimal impact techniques are covered.

6.11 Field Huts

The present number and distribution of field huts on Macquarie Island (see Map 4) provide adequate coverage for current safety, management, operational and scientific purposes.

The huts available for scientific research, monitoring and management programs in the reserve are located at Brothers Point, Green Gorge, Waterfall Bay, Hurd Point and Bauer Bay. The field hut at Caroline Cove was removed in 2001 following a landslip that buried much of the hut. The field huts at Lusitania Bay and Sandy Bay are no longer used but have historical significance (see Section 5.9).

Two of the huts are 'googies' made of bright orange fibreglass that have been installed at Brothers Point and Waterfall Bay to replace the old field hut at Sandy Bay and the old field hut at Lusitania Bay, respectively. Four temporary huts at Davis Point, Mt Eitel, Tiobunga Lake and Windy Ridge were removed in March 2003. The sites were cleaned up and natural rehabilitation of the sites will be monitored.

Objectives – Field Huts

The objectives for management of field huts are to:

- provide field bases for approved scientific research, monitoring, operational and management programs;
- minimise the environmental impact of human use of the reserve by confining impact to specific locations; and
- provide refuge in the event of an emergency.

Policies

- Field huts are available to support approved scientific research, monitoring, operational and management programs.
- Subject to the requirements of approved scientific, operational and management programs, the field huts will also be available for rest and recreation.
- Resupply operations for field huts must be carried out in accordance with Sections 6.5 and 6.14.
- All rubbish, waste materials and recyclables will be removed opportunistically or during resupply operations.

- Minimal impact methods will be used at each field hut to minimise the amount of rubbish and waste generated.

- Temporary structures may be installed for housing scientific equipment, carrying out management or scientific programs or for communication and support facilities. To minimise impacts, these structures will remain in place only for the duration of the program. Upon removal, sites will be cleaned up and rehabilitated if necessary.

- Any proposals to build structures will be considered through the PWS assessment process and must be approved by the Director (see Section 6.3).

Actions

- With advice from DPIW specialists, monitor natural rehabilitation of four former temporary hut sites at Davis Point, Mt Eitel, Tiobunga Lake and Windy Ridge for any active rehabilitation that may be required.

- Ensure minimal impact use guidelines for the use of field huts are understood and implemented.

- Upgrade current practices in remote area waste management, particularly in regard to disposal and minimisation of wastewater, kitchen waste, human waste and rubbish.

- Review type and placement of all antennae, aerials and guy wires around field huts to minimise bird strikes.

6.12 Station Management

The AAD operates the scientific station on the island and provides logistical support to all AAP personnel, including PWS staff (currently at no cost), working on the island. The station is the only land-based research site in thousands of square kilometres of ocean.

Scientific research, data collection and global monitoring programs have been conducted at Macquarie Island for over 50 years. Meteorological, atmospheric, seismic, tidal, geophysical and upper atmospheric physics monitoring facilities on the station form important links to international programs.

In the 1940s, rights to occupy, use and to carry out operations on Macquarie Island were granted by the Tasmanian Government to the Australian Government. The Australian Government has since occupied a large part of the Isthmus for over 50 years and has built the infrastructure to support AAP expeditions over this time. The logistic support provided by AAD has been instrumental in allowing important management and scientific research programs to be conducted over the years. The transport of cargo, PWS and DPIW personnel, logistic support on the island, medical support, accommodation, food and assistance in maintaining huts and tracks have been crucial to programs such as the integrated pest management program, flora and fauna research and the management of educational tourism. The State of Tasmania is now assuming a more active role in the management of the reserve due to its obligations for WHA management and under state and federal legislation.

The management of the station and human activities is governed by relevant policies in the AAD Environmental Policy (AAD 2001a) and the AAD Operations Manual (AAD 2003). The ANARE Code of Personal Behaviour also has environmental management implications for AAP personnel. These documents are subject to periodic review.

Objectives – Station Management

The objectives of station management are to:

- provide facilities and services for the continued support of scientific research, monitoring and management programs in the reserve;
- cooperate with AAD in achieving the highest environmental standards for construction, maintenance and the removal of buildings and facilities when their utility has expired (unless retained for management by the Director for historic values); and
- cooperate with the AAD in achieving the highest environmental standards for facilities management and waste management in the reserve.

Policies

- Environmental management of the station will accord with the AAD Operations Manual, Chapter 3 (AAD 2003) and any subsequent revisions.
- The RIC will be a member of the Station Environment Committee.
- Any further development of the station will be undertaken in accordance with the environmental impact and assessment processes set out in Section 6.3.
- Except for the old tip site, which contains burnt and buried material, current AAD facilities and buildings that are no longer required will be removed by AAD. If the Director wants to retain any of these for use or for their historic values, the Director will assume responsibility for their management and maintenance.
- If any facilities or buildings are removed, AAD will be responsible for ensuring that the sites are cleaned up and rehabilitated to a reasonable standard agreed to by the Director.
- The policies in Section 6.2.1 for Zone A will apply.

Actions

- The Director will commence discussions with the Australian Government in regard to concluding a formal agreement between the State and Australian Governments as soon as practicable to give effect to the provisions of this section of the management plan.
- In the interim, the Australian Government will continue to occupy, use and carry out operations on Macquarie Island under existing rights granted to the Australian Government in the 1940's.

6.13 Waste Management

Potentially historic material deposited prior to 1933 may have historical interest and is to come under provisions set out in Section 5.10.

The main concentration of rubbish in the reserve has been in an area on the Hasselborough Bay side of the Isthmus (Map 12) at the old tip site. Over the years most of the rubbish has been partially burnt and buried. The majority of surface rubbish has been removed and native vegetation, together with the alien *Poa annua,* has effectively re-colonised much of the old tip site. However, storms, large waves and the use of the site by moulting elephant seals have resulted in loss of vegetation and increased the potential for damage to seals from exposed metal or other rubbish. Storms in June 2003 exposed some of the old tip. There is also the possibility that the site is contaminated by heavy metals.

Relevant policies of the Operations Manual (AAD 2003) are used for waste minimisation, handling and management on station and in the field. The AAD's Environmental Management System (EMS) meets the requirements of the Australian/New Zealand Standard AS/NZS ISO 14001 (AAD 2003). The policies of this statutory management plan override those of the Operations Manual and the EMS, as those provisions may change from time to time. For example, burning at field huts will no longer be carried out and the Director may revise wildlife approach distances as necessary to protect threatened species. The onus is on all people who visit the reserve to use the best environmental practices possible.

The amount of potential waste material sent to the reserve is kept to a minimum. Appropriate waste material is burnt in a high-temperature incinerator on station and the residual ash together with non-combustible materials (glass and metals, building material etc.) or such materials as plastic and polystyrene, are returned to, mainland Australia for recycling or proper disposal. Kitchen waste is put through a macerator before being deposited in the marine waters of Garden Cove. Sewage is macerated and combined with kitchen sullage, then piped from the station into the sea. Article 5 of Annex III to the Protocol on Environmental Protection of the Antarctic Treaty provides for disposal of sewage and domestic liquid wastes into the sea where the sea ensures rapid dispersal. While this does not legally apply to waste disposal at Macquarie Island, maceration of kitchen sullage and sewage is to be used until such time that an alternative method is available. At field huts, rubbish that can be recycled and/or returned to Australia is to be placed securely in rodent-proof cage pallets for transfer to the station for incineration or return to Australia.

Marine debris is collected on an opportunistic basis and returned to the station if possible for disposal or return to mainland Australia. Drums and containers filled with unknown substances occasionally wash up on shore. Much of this rubbish has the potential to entrap or harm wildlife through entanglement or ingestion. Any fishing-related debris, entanglement or injury to wildlife is recorded for the information of the Marine Conservation Unit, DPIW, for reporting for conservation conventions.

More effort is required to minimise packaging and packing materials, particularly of foodstuffs, before they are shipped to Macquarie Island, in order to reduce the need for

incineration and return of waste materials. This is particularly an issue with foodstuffs and supplies at field huts.

Objectives – Waste Management

The objectives of waste management are to:

- reduce the amount of non-biodegradable waste in the reserve;
- minimise the adverse impacts of waste management and incineration;
- minimise the adverse impacts of disposal of biodegradable wastes on the environment and its wildlife; and
- minimise cumulative effects from vehicle and station washdown wastes.

Policies

- All rubbish that can be safely incinerated on station will be incinerated according to the provisions of the Tasmanian *Environmental Management and Pollution Control Act 1994* (EMPCA) and Regulations.
- Due to the sensitivity of the environment, liaise with the AAD in regard to upgrading the incinerator for licensing under EMPCA and to meet the emission standards of the Tasmanian Environmental Protection Policy (Air Quality) 2004 for new or upgraded facilities.
- The amount of packaging and packing materials that are shipped to the reserve will be minimised.
- Any non-combustible materials, or materials such as plastic and polystyrene, will be returned to Australia for recycling or proper disposal.
- Hazardous wastes, including waste oils and fuel, will be transported, handled and stored in accordance with the relevant Australian Standards, the Tasmanian *Dangerous Goods Act 1998* and Regulations.
- Except for such waste fuels as may be reclaimed and locally recycled, all waste oils and fuels must be removed from the reserve at the earliest reasonable opportunity.
- The use of radioactive materials in the reserve for scientific purposes must be authorised in writing by the Director and Antarctic Animal Care and Ionising Radiation Usage Ethics Committee (Ethics Committee).
- No radioactive waste material may be deposited in the reserve.
- If reasonably possible, flotsam and jetsam, including drums and containers, will be secured on shore to reduce entanglement and ingestion risk to wildlife, or returned to station for incineration or opportunistic removal from the reserve during resupply and rubbish-removal operations.

- At field huts, human faeces will be deposited in the sea. Elsewhere in Zone B, human faeces will be bagged and carried to the sea or back to the station.
- No food intended for human consumption, particularly poultry produce, will be fed to wildlife.
- Rubbish will not be burned at field huts, to reduce the risks of fuel spills and associated environmental impacts.

Actions

- Ensure that the incinerator is licensed, operates at maximum efficiency and meets the required operating standards.
- Liaise with AAD in regard to upgrading sewage and kitchen sullage treatment on station, particularly in regard to current disposal of waste in the marine environment.
- Liaise with AAD in regard to reducing the amount of packaging and packing materials shipped to the reserve.
- Monitor old tip site for exposure of rubbish such as metal objects that have the potential to injure moulting elephant seals, and remove them where possible.
- Liaise with AAD in regard to testing and clean-up operations that may be necessary should heavy metal contamination be evident at the old tip site.
- Encourage the recording and collection of any marine debris for return to Australia. If the items are too large to carry back to station, note their location and secure where possible for pick up by helicopter or small boat during resupply and rubbish removal operations.
- Educate all visitors to the reserve in minimal impact methods, waste management and not feeding wildlife.
- Investigate the feasibility of establishing a cement base area for vehicle washdown that drains into interceptor or storage pits, to control the accumulation of washdown waste and minimise cumulative impacts.

6.14 Fuel Supply and Storage

Bulk fuel is stored in the reserve for the purpose of running the station facilities and heating the buildings and for carrying out any of the operations permitted in Section 6. No more than 18 months' estimated requirement of fuel is stored at any one time in the reserve. Bulk fuel is provided to the station by ship-to-shore transfer via a lay-flat hose during resupply operations. It is stored in bunded fuel tanks at the fuel farm in Zone A (see Map 12). Flammable liquids, flammable gas and compressed gas are separated and stored in designated facilities.

The field huts have Remote Area Power Supply units capable of supplying 12-volt power from solar and wind generators and 240-volt power from a petrol

generator. The units hold all fuel drums (unleaded petrol and kerosene) under cover, and all fuel transfer is carried out over drip trays.

Objective – Fuel Supply and Storage

The objective for managing fuel supply and storage is to minimise accidental spillage or contamination of the environment.

Policies

- The methods and procedures used to transfer bulk fuel ashore must be in accordance with the Operations Manual (AAD 2003).
- Ship-to-shore transfer of fuel will not be carried out at night.
- Bulk fuel (more than 200 litres) may only be stored in Zone A and must be stored in accordance with Australian Standard 1940. Details of the occurrence of any fuel spillage greater than 20 litres will be forwarded to the Director, the Director of Environmental Management, DTAE and the AAD Operations Environmental Advisor at the earliest opportunity. The report must contain details of the type of fuel, quantity, any corrective measures taken and the obvious initial impact on the wildlife and environment. The Director may require those responsible for a fuel spillage to conduct a monitoring program on the effects of the spillage on the wildlife and the environment. The scope, duration and reporting of such a program will be determined after consultation with AAD and the Director, with advice from the Secretary.
- If a fuel spill of less than 20 litres results in injury or death to wildlife or damages historic material, then a report must be provided as set out in the policy above.
- Fuel spills will also be monitored in a cumulative sense.
- Where fuels are stored at field huts or other sites in Zone B (Section 6.2.2) for longer than two months, they must be stored in corrosion-proof containers if they cannot be stored in the RAPS unit at the huts.

Actions

- Use utmost care to avoid spillage of fuels while transfer operations are being undertaken.
- Investigate the use of commercially available sorbents to soak up fuel spilled on land or in shoreline rock pools.
- Use the procedures set out in the Operations Plan (AAD 2003), including the use of drip trays when refuelling vehicles.
- Report any fuel spillage equal to or greater than 20 litres and remediation measures to the AAD Operations Environmental Advisor at the earliest opportunity. Notify the Director of Environmental Control, DTAE.

- Prepare and provide guidelines for the remediation/clean up of fuel spills of less than 20 litres using appropriate techniques, particularly for those locations where minor spills tend to recur.

6.15 Enforcement

Within the reserve, authorised staff of the PWS are responsible for enforcing the provisions of the *National Parks and Reserves Management Act 2002*, the *Nature Conservation Act 2002*, the *Threatened Species Protection Act 1995*, the *Whales Protection Act 1988*, the National Parks and Reserved Land Regulations 1999, the Wildlife Regulations 1999, and any other Acts for which staff may be authorised.

The Secretary, DTAE, has delegated powers to enforce provisions of the Australian Government *Historic Shipwrecks Act 1976.*

Any person within Australian territory is subject to the provisions and penalties of the EPBCA and any other applicable Australian legislation that authorised AAD officers on station are empowered to enforce.

A service level agreement between the State and Australian Governments for consistent management of the adjacent marine reserves has been agreed (see Appendix 8). The DEH recognises that possible illegal fishing by foreign fishing vessels and the lack of regular surveillance are major issues for the Australian Government Marine Park. The DEH will consult with AFMA, DPIW and fishers to develop a coordinated approach to compliance and enforcement (EA 2001). The DEH is currently negotiating with Australian Customs for the implementation of a surveillance monitoring regime for Macquarie Island EEZ.

6.16 Emergency Management

The following sections describe some of the emergency situations that may arise in the reserve and the general policies and actions that should be applied. Where human life and safety is at risk, a general exemption from the prescriptions of this plan may be necessary.

Objective – Emergency Management

The objective of emergency management is to manage emergency situations so as to prevent human injury and loss of life.

General Policy for Emergencies

- Nothing in this plan shall be construed as preventing activities necessary for and directly associated with the preservation of human life and safety, including search and rescue activities.

- In an emergency, any reasonable actions required to preserve vessels, infrastructure and equipment, even when life or safety is not under immediate threat, may be undertaken.

- In such circumstances, a full report on the environmental impact of the activities shall be provided to the Director at the earliest reasonable opportunity.

Action

- Liaise with AAD in the development of emergency response plans.

6.16.1 Search and Rescue

Due to the isolated location of the reserve, responsibility for search and rescue lies with the SL. Search and rescue exercises are conducted by personnel in the reserve to ensure readiness in the event that a search and rescue team is required.

Objective – Search and Rescue

The objective of search and rescue is to respond quickly to locate missing persons or injured/sick parties in the field.

Policies

- The Station Leader will be responsible for search and rescue operations in the reserve.
- The RIC will respond to requests to facilitate search and rescue operations.

Actions

- Cooperate and assist in search and rescue operations.
- Educate and encourage visitors to adopt safe practices and provide them with sufficient information about potential hazards to enable them to make responsible decisions.

6.16.2 Oil Spills

An offshore oil spill at Macquarie Island, especially with onshore winds, is an extremely serious prospect in view of the abundance of shore-dwelling seals and seabirds and the enormous difficulties of undertaking clean-up/wildlife rescue operations in such an isolated location where weather and sea conditions are usually severe. The fact that a fishing vessel operates regularly off the west (onshore weather) side of the island is of added concern.

The largest oil spill in the reserve occurred in December 1987 when the AAD resupply vessel, the *Nella Dan*, ran aground near the station. Approximately 270,000 litres of oil, mainly light marine diesel, were released into the sea. The *Nella Dan* was scuttled in deep water, approximately 18 km out to sea, three weeks later (Scott 1994). A study of the shore community one year after the event showed greatly reduced densities of marine invertebrates in the lower intertidal and subtidal zones where the ship ran aground (Pople et al. 1990).

AAD vessels and tourist vessels usually anchor in the lee of the island, which reduces the likelihood of an oil spill reaching the coast from the anchorage one or more kilometres from shore. Equipment is available at the station in the event of a spill near the Isthmus, but it would be near impossible to contain an oil spill anywhere else. A Macquarie Island Station Oil Spill Contingency Plan has been prepared by the AAD and provides policies and procedures for dealing with nearshore oil spills in the waters of Buckles Bay.

The National Plan to Combat Marine Oil Spills has been developed by the Australian Maritime Safety Authority and includes a section on Macquarie Island which concludes that, in practice, very little could be done, except for attempting to clean oil off critical species such as albatrosses and young fur seals. The high-energy coastline would rapidly disperse many types of oil and the use of dispersal agents, even if possible, could do more harm than good.

Objectives – Oil Spills

- The objective is to respond quickly and as effectively as possible to oil spills in the waters of the reserve.

Policy

The Macquarie Island Station Oil Spill Contingency Plan will be used to deal with oil spills in the reserve.

Actions

- Liaise with the Secretary and AAD in regard to the development of an appropriate oil spill response plan for the reserve.
- Review the National Plan to Combat Marine Oil Spills for the marine waters of the reserve in consultation with AAD, the Australian Maritime Safety Authority and the Secretary. The review should consider the quantities and types of fuels being carried by all vessels likely to visit the reserve and should include an equipment strategy, which addresses storage, maintenance, use and training requirements.
- In the event of an oil spill or other pollution event in the reserve, notify the Director of Environmental Management, DTAE.

6.16.3 Unusual Animal Deaths or Disease Outbreaks

AAD has developed a draft response plan for the discovery of unusual animal deaths or possible outbreaks of animal disease (AAD 2003). This plan should be followed as far as possible until such time as a plan specific to Macquarie Island Nature Reserve can be developed.

Objectives – Unusual Anima Deaths or Disease Outbreaks

The objectives are to:

- be able to respond effectively in the event that sick or dead animals are discovered in the reserve in unusually high numbers or with signs that suggest disease;
- obtain information on the species involved, the extent of affected animals and the cause; and
- reduce the likelihood of people spreading the disease.

Policies

- A response plan for the discovery of unusual animal deaths or disease in the reserve will be developed. In the interim, the Director will rely upon the Draft Response Plan for the Discovery of Unusual Animal Deaths (AAD 2003) developed by AAD, to the extent that it may be applicable.
- The RIC will work cooperatively with the SL in implementation of the response plan.
- The RIC will immediately notify the Director, who will then notify the Secretary and the Chief Veterinary Officer (Tasmania).

Actions

- Develop a response plan for the discovery of unusual animal deaths or disease in the reserve.
- Develop a protocol to allow emergency scientific permits to be issued for collection of samples (see Section 6.8).
- Liaise with DPIW in regard to the development of a response plan for plant disease in the reserve.

6.16.4 Emergency Evacuation

The procedures set out in the Macquarie Island Emergency and Contingency Manual (MIECM) 2001 (AAD 2001b) will be used.

7 Public Awareness and Community Support

7.1 Promotion and Presentation of the Reserve

Public awareness of, appreciation and support for the reserve and its World Heritage values should be encouraged off-reserve as far as possible through educational films, media coverage, exhibitions, books and other means. Educational tourism will continue into the foreseeable future (see Section 6.9), but will continue to be limited by the sea travel required to reach the reserve and environmental and management constraints.

7.2 Information, Interpretation and Education

Information, interpretation and education are tools for increasing awareness, understanding and appreciation of the reserve. They are also important for management of human use of the reserve. Macquarie Island and its special values are of enormous interest to local, national and international audiences. For most people, the natural and historical values of the reserve are promoted and presented through off-reserve media, such as television, the Internet, exhibitions, books, cards, posters, newspapers and magazines.

Off Reserve

Awareness and appreciation of the values of Macquarie Island Nature Reserve and World Heritage Area (WHA) are promoted in Tasmania through educational facilities such as the Subantarctic Plant House at the Royal Tasmanian Botanical Gardens (RTBG), the Tasmanian Museum and Art Gallery (TMAG), the Queen Victoria Museum, the Institute for Antarctic and Southern Ocean Studies at the University of Tasmania, and the Australian Antarctic Division (AAD) display area. Educational festivals such as the Antarctic Midwinter Festival keep Macquarie Island in focus. Tasmanian photographers have produced posters, calendars, screen-savers and cards with photographs of Macquarie Island and its wildlife. The Macquarie Island booklet (PWS 2001) is available at bookstores in Hobart. Brochures about Macquarie Island's geology and wildlife are available from the Parks and Wildlife Service (PWS). The ABC and other film producers have made a number of documentaries about the reserve.

On the Internet

There are several sites on the Internet devoted to Macquarie Island. The World Heritage Site describes the reserve particularly in terms of its WHA values. The Department of Primary Industry and Water (DPIW) website provides general information about the reserve and its values. The AAD website provides extensive information about Australian National Antarctic Research Expeditions(ANARE) operations, the natural and cultural history of the reserve, maps and other data, including a photographic archive) and links to other electronic resources. The Fahan School in Hobart has developed a site for

educational use that is accessible from the DPIW site. The URLs for these sites are as follows:

- http://www.parks.tas.gov.au/macquarie/index.html
- http://www.deh.gov.au/heritage/worldheritage/sites/macq/index.html
- http://www.aad.gov.au/default.asp?casid=7151
- http://www.parks.tas.gov.au/fahan_mi_shipwrecks/index.htm

The Macquarie Island Citation Database lists over 1300 refereed scientific papers, published and unpublished reports, papers and theses and is available at:

- http://www.DPIW.tas.gov.au/library/Macquarie.htm

On Reserve

Induction and environmental education training for personnel on the island is provided by PWS and AAD. Minimal impact information is reinforced through station environment meetings, the station environment officer, the Ranger in Charge and the Station Leader. The Operations Manual, Australian Antarctic Program, Field Manual and Field Training Officers provide further information and education for personnel living in the reserve for a few days to 18 months.

At commercial educational Tourism Management Areas, boardwalks, viewing platforms, interpretive signs and guiding staff are provided for commercial educational tourism operations that visit the island (see Section 6.2.5). Minimal impact guidelines, particularly in regard to behaviour around wildlife, are stressed. A package of information, including brochures and notesheets, is provided to visitors on embarkation on commercial educational tourism voyages. This package also includes notes about current scientific research projects and monitoring programs in the reserve.

Objectives – Information, Interpretation and Education

The objectives of providing information, interpretation and education are to:

- promote public awareness, understanding and appreciation of and support for environmental protection and natural diversity (including geodiversity and biodiversity) conservation in general;
- enhance public awareness and community support for the protection, conservation and rehabilitation of the natural and historical values of the reserve;
- minimise human impact on the reserve and its natural and historical values; and
- promote public understanding of the management and research activities undertaken in the reserve.

Policies

Off Reserve

- Off-reserve interpretation, education and awareness of the reserve and its values will be facilitated, promoted and encouraged. Use of facilities such as the Subantarctic Plant House at the RTBG for interpretation and education programs will be encouraged**.**

- Liaison with Antarctic Tasmania, AAD, museums, RTBG and the Polar Network about promoting the links between Hobart and Macquarie Island will be encouraged.

On Reserve

- Except where required for protection and conservation, the use of signs, boardwalks, viewing platforms and other tourist facilities will be minimised to protect the wilderness character of the reserve.

- Education of all visitors about quarantine issues, minimal impact methods, behaviour around wildlife, wildlife viewing distances and photography will be undertaken prior to arrival and on-reserve as a priority.

- Media visits to the reserve will be subject to all the same access, quarantine and minimal impact requirements as any other visits.

- Media visits to the reserve will be permitted to promote significant changes and events associated with research, management and conservation activities. Media visits will not be permitted if material can be obtained from existing sources.

Actions

- Continue to implement the Macquarie Island Interpretation Plan (PWS 1999b) and use it to guide development of interpretation for the reserve. Review the plan in 2008.

- Research and provide further interpretation of the significance of the reserve in terms of its biogeographic affinities with other subantarctic islands and, in particular, New Zealand subantarctic islands.

- Minimise the use of signs, walkways, fences and viewing platforms at commercial educational Tourism Management Areas to those essential for protection and conservation of wildlife, vegetation and historic sites and for human safety.

- Minimise the use of signs to those necessary for interpretation of World Heritage values, natural and historic values and for human safety.

- Provide information about potential hazards and encourage visitors to adopt and use safe practices.

7.3 Public Consultation and Community Involvement

Three options for encouraging public consultation and community involvement in the management and protection of Macquarie Island Nature Reserve and World Heritage Area were presented in the draft management plan for public comment. The majority of respondents agreed that the establishment of a Macquarie Island World Heritage Area Consultative Committee would best provide for continuing liaison between the State Government, the Australian Government and independent experts concerned with all aspects of management of the reserve.

Macquarie Island World Heritage Area Consultative Committee

The establishment of a Macquarie Island World Heritage Area Consultative Committee (MIWHACC) would provide the opportunity for continuing liaison between the State Government, the Australian Government and independent experts concerned with the future of the reserve.

The principal role of MIWHACC would be to provide advice to the relevant Australian and State Ministers, DPIW and Department of Tourism, Arts and the Environment (DTAE) on matters relating to the management of the reserve and to assist in identifying funding sources for management and research projects. Advice from MIWHACC may include recommendations on management of tourism activities, monitoring programs, research projects, Australian Government marine park management and planning, implementation of the management plan and any other advice to enable improved management of the reserve. The Chairperson would be appointed jointly by the Australian Government and the State Government of Tasmania. It is envisaged that MIWHACC would include national and international experts.

Macquarie Island Forum

The former Governor of Tasmania, Sir Guy Green, has held four Antarctic forums to promote Tasmania's role in the subantarctic and Antarctica. Macquarie Island values and management issues featured at several of these forums.

Following this model, either associated with any future Antarctic forums or as a separate event, an open forum to discuss reserve management priorities and research results, and to promote public understanding and support for the reserve, could be held regularly or occasionally. Interest in a Macquarie Island forum would be expected from research scientists, educational tourism operators, Polar Network, members of the ANARE Club. the general public, AAD, Department of Environment and Heritage(DEH), DPIW, DTAE, TMAG, RTBG, Antarctic Tasmania and other stakeholders.

One of the aims of the Macquarie Island forum would be to continue the liaison, cooperation and understanding between concerned parties that has been achieved at previous Antarctic forums.

Objectives – Public Consultation and Community Involvement

The objectives of public consultation and community involvement are to:

- provide for public consultation and community involvement in management and research activities in the reserve;
- develop community support, appreciation and understanding of reserve values and management and research activities in the reserve; and
- promote a positive image of the reserve and its contribution to the community.

Policies

- Liaise with the Australian Government concerning establishment and membership of a Macquarie Island World Heritage Area Consultative Committee.
- Liaise with AAD, TMAG and Antarctic Tasmania regarding promotion of and support for future proposals for an Antarctic forum with a Macquarie Island component as a means of fostering understanding and continued cooperation in subantarctic and Antarctic matters.
- Relevant people, communities, organisations and groups will be consulted when their interests may be affected.

Actions

- Develop a range of mechanisms and opportunities for consulting with people interested in protection, conservation, and management of the reserve.
- Provide information on current management, monitoring and research programs on the PWS website.

8 Other Issues

8.1 Joint Management Arrangements

The boundary of the Macquarie Island Nature Reserve is the territorial limit of state waters at 3 nm. The boundary of the Macquarie Island World Heritage Area (WHA) includes the terrestrial reserve and includes the state waters from three nm to 12 nm around the island and outlying islets. Macquarie Island Marine Park extends from the eastern boundary of the reserve from 3 nm to 200 nm (see Map 3).

Complementary management strategies and joint management arrangements between the State and Australian Governments effectively mean that the protected marine areas act as extensions of each other. This is particularly important for a place like Macquarie Island where the majority of the marine mammals and seabirds depend on a far greater area of the surrounding seas than is included in these protected areas. A Memorandum of Understanding regarding cooperative management of the state waters to 3 nm, the Territorial Sea and WHA waters to 12 nm and the Macquarie Island Marine Park has been agreed between the Tasmanian and Australian Governments (see Appendix 8).

The Australian Government waters of the Exclusive Economic Zone (EEZ) and the waters of the WHA adjoining the western and northern boundaries of the reserve (see Maps 2 and 3) are subject to the Macquarie Island Toothfish Fishery Management Plan 2006.

The Macquarie Island EEZ and areas of claimable extended continental shelf are included in the area covered by the South-east Regional Marine Plan (NOO 2004) prepared by the National Oceans Office.

The Macquarie Island Biosphere Reserve should be extended to include these areas. As a biosphere reserve (see Section 1.3.2), incorporating the surrounding marine environment means that the objectives of studying ecological interactions and monitoring global change can be more fully realised. Regional cooperation to achieve an ecosystems-based approach to management should be encouraged.

Objectives – Joint Management Arrangements

The objectives of joint management arrangements are to:

- improve conservation of the protected areas of the marine environment and the natural values of the reserve;
- provide effective administrative management of the federal and state reserves; and
- encourage international cooperation in marine protected area management.

Policies

- Management of the protected marine areas around the reserve will be cooperative and complementary as set out in the Service Level Agreement between the Australian and Tasmanian Governments for the Cooperative Management of Marine Parks (Appendix 8).
- Regional cooperation to adopt an ecosystems-based approach to management of the marine areas surrounding Macquarie Island will be encouraged.

Actions

- Upgrade the National Estate listing and the Biosphere Reserve listing to include the protected areas of the surrounding marine environment.
- Encourage cooperation between Australia and New Zealand in regard to the management and patrol of waters in adjacent EEZ areas.

8.2 Statutory Authorities

Section 35 of the *National Parks and Reserves Management Act 2002* provides that certain state authorities may not exercise their powers in a reserve unless authorised by a management plan. There are currently no statutory authorities within the meaning of the Act operating within the reserve, so there is no need to restrict the exercise of their statutory powers through this plan.

This section describes the Australian and state statutory authorities with responsibilities toward the management of the reserve.

8.2.1 Quarantine Tasmania

Quarantine Tasmania is the delegated authority under the federal *Quarantine Act 1908* to act for the Australian Quarantine and Inspection Service in regard to the control of quarantine matters arriving in Tasmania (including Macquarie Island) from international sources. Goods arriving into the reserve from mainland Tasmania and movement and activities within the reserve are controlled by either the *Tasmanian Nature Conservation Act 2002* or the *Tasmanian National Parks and Reserves Management Act 2002*. It is intended that Macquarie Island will be declared a Control Area under the Tasmanian *Plant Quarantine Act 1997* in regard to inspection of cargo, equipment and personal belongings from Macquarie Island to prevent the movement of plant pests and diseases into the mainland of Tasmania.

8.2.2 Australian Customs Service

Vessels sailing to and from Australia across international waters are subject to Australian Customs regulations.

8.2.3 Australia Post

Macquarie Island is serviced by Australia Post in that a person on-station is appointed each year as the postal agent.

8.3 Implementation of the Plan

The Director is required to give effect to this management plan under the *National Parks and Reserves Management Act 2002*. An implementation schedule, setting out actions, responsibility and priorities is given in Appendix 9.

The plan does not bind the Secretary, DPIW, although the Director may enter into arrangements with the Secretary in relation to the *Nature Conservation Act 2002* for the purpose of furthering the objectives of that Act. The intention is that the Secretary may provide advice, resources and/or staff as part of that arrangement.

This statutory plan does not bind the Australian Government (see Section 1.5), but the Director will consult with the Director of the Australian Antarctic Division (AAD) and any other Australian Government agency in regard to matters that may have resource or operational implications for their activities. These agencies are subject to policy priorities of the Australian Government and their own resource and operational constraints.

Objective – Implementation

The objective of implementation is to give effect to the actions prescribed in this management plan.

Policies

- The prescriptions of this plan will be subject to the provision of funding and other resources sufficient to meet them, and may be prioritised by the Director of National Parks and Wildlife at the Director's discretion according to resource availability.
- To coordinate effective implementation of this management plan, a rolling implementation program of three years duration, and linked to relevant operational plans, will be developed.
- The implementation program will identify actions prescribed in this management plan, their priority and responsibility for implementation.
- The implementation program will conform with the management plan and other approved plans identified herein, such as recovery plans, action plans, threat abatement plans, historic site conservation plans, and interpretation plans.
- The Director will consult with the AAD and other Australian Government agencies on any matters that may have resource or operational implications for them.

Actions

- Train staff to understand and implement the management plan.
- Review the implementation of the management plan annually and revise the implementation program if necessary. Base any revision on analysis of past progress and incorporate newly identified requirements. Add a further year's program at each annual review.
- Annually evaluate the outcomes of management against the objectives of the management plan.
- Take into account any findings and recommendations from research, monitoring and evaluation of the condition and management of the reserve.

8.4 Monitoring and Evaluation

Under the terms of Article 29 of the Convention concerning the Protection of the World Cultural and Natural Heritage, adopted by the General Conference of UNESCO in 1972, States Parties are invited to submit reports on the application of the World Heritage Convention. These reports should be submitted every six years in two sections: a periodic report on the application of the Convention overall, and a periodic report on the state of conservation of each World Heritage property.

The UNESCO World Heritage Committee has decided to have a year of reflection in 2007 in order to study and reflect on the results of the first cycle of reporting & consider the format and other needs for the next cycle of periodic reporting.

According to previous information provided by the World Heritage Committee, the first periodic report for Macquarie Island WHA should update the information provided in the original nomination dossier. If the committee has substantively revised the criteria, or if improved identification or knowledge of specific outstanding universal values of the property is available, the report should also identify the need to revise the listing statement of significance. The report should review whether the World Heritage values of the reserve are being maintained. It is also necessary to report on the implementation and effectiveness of protective legislation, as well as management and planning for the property. The report should also provide an assessment of the human and financial resources required, research, education and awareness-building activities related to the reserve. Threats and other factors affecting the property and the measures taken to deal with them should be provided. The report should provide a summary of conclusions and recommended actions.

Key desired outcomes and key indicators are given in Appendix 10 of the plan. These will be used to monitor and evaluate the success of the plan in meeting the objectives for management, the effectiveness of management practices, and the effects of management actions on the World Heritage, Biosphere Reserve and National Estate values of the reserve as identified in Section 1.3. Monitoring and evaluation will provide information necessary for the report and to inform the Director of any necessary changes or modifications for ongoing management of the reserve.

Objectives – Monitoring and Evaluation

The objectives of monitoring and evaluation are to:

- provide an assessment as to whether the World Heritage values of the property are being maintained over time;
- provide updated information about the World Heritage property to record the changing circumstances and state of conservation of the property; and
- monitor and evaluate the implementation of the management plan.

Policies

- A State of the World Heritage Report will be prepared when required by the Australian Government to fulfil its obligations as a State Party to the World Heritage Convention.

Actions

- prepare a State of the Macquarie Island World Heritage Area Report using the explanatory notes and format provided by the World Heritage Committee. In brief, the report should provide details in regard to the following:
  - whether the statement of significance is still appropriate or should be revised based on changing circumstances or new knowledge;
  - whether the World Heritage values of the reserve are being maintained and how the state of conservation of the property has changed over time;
  - an evaluation of the implementation and effectiveness of protective legislation and this management plan;
  - an evaluation of the threats or other factors affecting the property and the actions taken to deal with them; and
  - results of monitoring of the key indicators given in Appendix 10 of this plan.

8.5 Review of the Plan

As required for World Heritage Areas under the *Environment Protection and Biodiversity Conservation Act 1999*, this plan will be reviewed seven years from the effective date of its gazettal in the Tasmanian *Government Gazette*.

Glossary

Alien species are any organisms introduced directly or indirectly by human activities.

Biodiversity (biological diversity) means the variety of life forms: the different plants, animals and micro-organisms, and the ecosystems they form. It is usually considered at four levels: genetic variation, species diversity, ecosystem diversity and community diversity.

Conservation means all the processes and actions of looking after a place so as to retain its significance, always including protection, maintenance and monitoring.

Earth processes means the interactions, changes and evolutionary development of geodiversity over time.

Geoconservation means the conservation of geodiversity.

Geodiversity means the range or diversity of geological (bedrock), geomorphological (landform) and soil features, assemblages, systems and processes which exist naturally.

Historic heritage is the collection of places, objects, experiences and other things that a community values and wants to keep for its future and which provide a sense of its past and who they are.

Introduced species means a translocated or alien species occurring at a place outside its historically known natural range as a result of intentional or accidental dispersal by human activities.

Native species means a species that occurs at a place within its historically known natural range and that forms part of the natural biodiversity of a place.

Natural integrity means the degree to which a natural system retains its condition and natural rate of change in terms of size, biodiversity, geodiversity and habitat.

Natural landscape means a large, relatively undisturbed area with topographic and catchment integrity where natural processes continue largely unmodified by human intervention.

Protection means taking care of a place by maintenance and by managing impacts to ensure that significance is retained.

Threatened species means a species listed in the Schedules of the Tasmanian *Threatened Species Protection Act 1995* and/or the Australian Government *Environment Protection and Biodiversity Conservation Act 1999.*

Abbreviations Used in the Text

AAD	Australian Antarctic Division
AAE	Australasian Antarctic Expedition
ACAP	Agreement on the Conservation of Albatrosses and Petrels
AFMA	Australian Fisheries Management Authority
AAP	Australian Antarctic Program
ANARE	Australian National Antarctic Research Expeditions
ANZECC	Australian and New Zealand Environment and Conservation Council
APFZ	Antarctic Polar Frontal Zone
AQIS	Australian Quarantine Inspection Service
BCB	Biodiversity Conservation Branch (DPIW)
CAMBA	Agreement between the Government of Australia and government of the People's Republic of China for the Protection of Migratory Birds and their Environment
CCAMLR	Convention on the Conservation of Antarctic Marine Living Resources
CMS	Convention on the Conservation of Migratory Species of Wild Animals
DEH	Department of Environment and Heritage
DOC	Department of Conservation (New Zealand)
DPIW	Department of Primary Industries and Water (Tasmania)
DTAE	Department of Tourism, Arts and the Environment (Tasmania)
EA	Environment Australia
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMPCA	*Environmental Management and Pollution Control Act 1994* (Tasmania)
EPBCA	*Environment Protection and Biodiversity Conservation Act 1999*
FAO	Food and Agriculture Organisation
GPS	Global Positioning System
HPZ	Highly Protected Zone (of the Macquarie Island Marine Park)
ICOMOS	International Council on Monuments and Sites
IRBs	Inflatable rubber boats
IUCN	World Conservation Union
JAMBA	Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction
LUPAA	*Land Use Planning and Approvals Act 1993* (Tasmania)
MIWHACC	Macquarie Island World Heritage Area Consultative Committee
MARPOL	International Convention for the Prevention of Pollution from Ships 1973
MIMP	Macquarie Island Marine Park
MIRAG	Macquarie Island Research Advisory Group
NRSMPA	National Representative System of Marine Protected Areas
NCA	*Nature Conservation Act 2002* (Tasmania)
NES	Matters of National Environmental Significance, EPBCA 1999
nm	Nautical miles
NOO	National Oceans Office
NRM	Natural Resource Management
NPRMA	*National Parks and Reserves Management Act 2002* (Tasmania)
PWS	Parks and Wildlife Service, DTAE
RIC	Ranger in Charge, PWS, DTAE
RMPS	Resource Management and Planning System
RiSCC	Regional Sensitivity to Climate Change in Antarctic terrestrial and limnetic ecosystems
RTBG	Royal Tasmanian Botanical Gardens
SL	Station Leader, AAD
SMA	Special Management Area
THO	Tasmanian Heritage Office, DTAE
TMA	Tourism Management Area
TMAG	Tasmanian Museum and Art Gallery
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WHA	World Heritage Area

References

These are only the references used in preparation of this plan. The Macquarie Island Citation Database is a comprehensive list of all reports, refereed papers and theses published as a result of research and other activities and is available at: http://www.DPIW.tas.gov.au/library/Macquarie.htm

Adamson, DA, Selkirk, PM and Colhuon, EA 1988, Landforms of aeolian, tectonic and marine origin in the Bauer Bay – Sandy Bay region of subantarctic Macquarie Island. In MR Banks and SJ Smith (eds.) *Proceedings of the symposium on Macquarie Island,*. The Royal Society of Tasmania, Hobart.

Adamson, DA, Selkirk, PM, Price, DM and Ward, N 1995, Uplift of the Macquarie Ridge at Macquarie Island: Pleistocene evidence from raised beaches and topography, in PG Quilty, 'Climate Succession and Glacial History of the Southern Hemisphere over the Past Five Million Years',. *ANARE Research Notes* 94: 3-5.

Adamson, DA, Selkirk, PM, Price, DM, Ward, N and Selkirk, JM 1996, 'Pleistocence uplift and paleoenvironments of Macquarie Island: evidence from palaeobeaches and sedimentary deposits',. *Papers and Proceedings of the Royal Society of Tasmania* 130 (2): 25-32.

Australia ICOMOS Inc. 1999, *The Burra Charter* (The Australia ICOMOS Charter for Places of Cultural Significance), Australia ICOMOS Inc, Sydney.

Australian Antarctic Division (AAD) 2000, *Looking South – The Australian Antarctic Program into the 21st century*, AAD, Kingston.

Australian Antarctic Division (AAD) 2001a, *Australian Antarctic Division Environmental Policy*, AAD, Kingston.

Australian Antarctic Division (AAD) 2001b, *The Macquarie Island Emergency and Contingency Manual*. AAD, Kingston.

Australian Antarctic Division (AAD) 2003, *Australian Antarctic Division Operations Manual*: *Chapter 3 Environment*, AAD, Kingston.

Australian Fisheries Management Authority 2006, *Macquarie Island Toothfish Fishery Management Plan 2006*, Australian Fisheries Management Authority, Barton ACT.

Bergstrom, DM, 1997, 'Ecosystem function with climate change in subantarctic terrestrial environments,' *Man & The Biosphere Northern Science Network Newsletter* 21.

Bergstrom, DM and Selkirk, PM 1987, 'Reproduction and dispersal of mosses on Macquarie Island', *Symposia Biologica Hungarica* 35, 247-257.

Bergstrom, DM and Chown, SL 1999, 'Life at the front: history, ecology and change on southern ocean islands', *Trends in Ecology and Evolution* 14, 472-477.

Blamey, N 1987, *Walking track management manual: A guide to the construction, restoration and maintenance of walking tracks*, Department of Lands, Parks and Wildlife, Tasmania and Australian National Parks and Wildlife Service, Australian Capital Territory.

Brothers, NP 1984, 'Breeding distribution and status of burrow-nesting petrels at Macquarie Island', *Australian Wildlife Research* 11:113-131.

Brothers, NP 1985, 'Breeding biology, diet and morphometrics of the King shag, *Phalocrocorax albiventer purpurascens*, at Macquarie Island', Australian Wildlife Research 12:81-94.

Brothers, NP 1991, 'Albatross mortality and associated bait loss in the Japanese longline fishery in the Southern Ocean', *Biological Conservation*, 55: 255-268.

Brothers, NP and Copson, GR 1988, 'Macquarie Island flora and fauna management – Interpreting progress and predictions for the future', *Papers and Proceedings of the Royal Society of Tasmania* 122 (1): 129-136.

Brothers, NP and Skira, IJ 1984, 'The weka on Macquarie Island', *Notornis*, 31:145-154.

Brothers, NP, Eberhard, IE, Copson, GR and Skira, IJ 1982, 'Control of rabbits *Oryctolagus cuniculus* on Macquarie Island by myxomatosis,' *Australian Wildlife Research* 9(3): 477-485.

Brothers, NP, Skira, IJ and Copson, GR 1985, 'Biology of the feral cat, *Felis catus* (L.) on Macquarie Island', *Australian Wildlife Research* 12: 425-436.

Brown, S and Townrow, K 1989, 'Conservation Plan for Cultural Resources on Macquarie Island', unpublished report, Department of Parks, Wildlife and Heritage, Hobart.

Bryant, S 1994, *Conservation of the fairy prion and other seabirds on Macquarie Island, Tasmania*, Parks and Wildlife Service, Tasmania.

Buckney, RT and Tyler, PA 1974, 'Reconnaissance limnology of subantarctic islands II. Additional features of the chemistry of Macquarie island lakes and tarns', *Australian Journal of Marine and Freshwater Research* 25: 89-95.

Bunt, JS 1954, 'The soil-inhabiting nematodes of Macquarie Island', *Australian Journal of Zoology* 2(2):264-274.

Campbell, AJ 1901, *Nests and Eggs of Australian Birds,* the Author, Sheffield, Tasmania.

Cooper, J & Avery, G (Eds) 1986, *Historical Sites at the Prince Edward Islands,* Foundation for Research Developments, South Africa.

Copson, GR 1984, 'An annotated atlas of the vascular flora of Macquarie Island', *ANARE Research Notes*, 18:p70.

Copson, GR 1986, 'The diet of the introduced rodents *Mus musculus* L. and *Rattus rattus* L. on subantarctic Macquarie Island', *Australian Wildlife Research*, 13: 441-445.

Copson, GR 1988, 'The status of the black-browed and grey-headed albatrosses on Macquarie Island', *Papers and Proceedings of the Royal Society of Tasmania*, 122 (1): 137-141.

Copson, GR 1994, 'Cetacean sightings and strandings at subantarctic Macquarie Island', 1968 to 1990, *ANARE Research Notes* 91:15.

Copson, GR 1995a, 'Conservation measures taken at Macquarie Island 1986-1992' in PR Dingwall (ed.), *Progress in conservation of the Subantarctic Islands. Proceedings of the SCAR/IUCN Workshop on Protection, Research and Management of Subantarctic Islands*, Paimpont, France, 27-29 April, 1992, World Conservation Union, Gland.

Copson, GR 1995b, 'An integrated vertebrate pest strategy for subantarctic Macquarie Island', in: *Proceedings of the 10th Vertebrate Pest Control Conference*, Hobart, May 1995.

Copson, GR 1995c, 'Ecological restoration at subantarctic islands: The issues', in PR Dingwall (ed.) *Progress in conservation of the Subantarctic Islands. Proceedings of the SCAR/IUCN Workshop on Protection, Research and Management of Subantarctic Islands*, Paimpont, France, 27-29 April, 1992. Gland, World Conservation Union.

Copson, GR 2002, *Integrated Vertebrate Pest Management on Subantarctic Macquarie Island 1997–2002*. Final Report for National Heritage Trust, Department of Primary Industries, Water and Environment, Hobart.

Copson, GR 2004, *Draft Plan for the Eradication of Rabbits and Rodents on Subantarctic Macquarie Island*, Report for National Heritage Trust, Department of Primary Industries, Water and Environment, Hobart.

Copson, GR, Brothers, NP and Skira, IJ 1981, 'Distribution and abundance of the rabbit, *Oryctolagus cuniculus* (L.) at subantarctic Macquarie Island', *Australian Wildlife Research*, 8: 597-611.

Copson , GR and Leaman, EG 1981, '*Rumex crispus* L. (Polygonaceae) – a new record for Macquarie Island', *New Zealand Journal of Botany* 19: 401-404.

Copson, GR and Rounsevell, DE 1987, The abundance of Royal Penguins *(Eudyptes schlegeli*, Finsch) breeding at Macquarie Island, *ANARE Research Notes* 41.

Copson, GR and Whinam, J 1998, 'Response of vegetation on subantarctic Macquarie Island to reduced rabbit grazing', *Australian Journal of Botany* 46(1): 15-24.

Copson, G and Whinam, J 2001, 'Review of ecological restoration program at subantarctic Macquarie Island: Pest Management progress and future directions', *Ecological Management and Restoration.* 2 (2): 129-138.

Croome, R 1984, 'Limnological studies on Macquarie Island', *Tasmanian Naturalist* 78: 26-27.

Cumpston, JS 1968, Macquarie Island, *ANARE Scientific Reports*, Series A(1), Antarctic Division.

Dartnall, HJG 1993, 'The rotifers of Macquarie Island', *ANARE Research Notes* 89(6): 1-41.

Debenham, F (ed) 1945, *The voyage of Captain Bellinghausen to the Antarctic Seas, 1819-1821*, Vol. 2, Hakluy Society, London.

Department of Conservation (DOC) 1998, *Conservation Management Strategy – Subantarctic Islands 1998–2008*, DOC, New Zealand.

Department of Conservation (DOC) 2000, 'Assessment of Environmental Effects for Norway Rat (*Rattus norvegicus*) Eradication in the Campbell Island National Nature Reserve Operational Area', unpublished report, DOC, New Zealand.

Department of Conservation (DOC) 2003, 'Campbell Island Eradication–Good Innovative Practice', <http://www.doc.govt.nz/Conservation/Offshore-Islands/Campbell-Island-Rat-Eradication>(Accessed 5 August 2003).

Department of Environment, Sport and Territories (DEST) in association with the Tasmanian Parks and Wildlife Service 1996, *Nomination of Macquarie Island by the Government of Australia for Inscription on the World Heritage List*.

Department of Parks, Wildlifeand Heritage, Tasmania, 1991, *Macquarie Island Nature Reserve Management Plan 1991*, Hobart.

Department of Primary Industries, Water and Environment (DPIWE) 2002, *Tasmania's Nature Conservation Strategy 2002-2006: An action plan to protect Tasmania's natural diversity and maintain ecological processes and systems*, DPIWE, Hobart.

Department of Primary Industries, Water and Environment (DPIWE) 2003a, 'Environmental Management Goals for Tasmanian Surface Waters: Huon Valley Catchments', unpublished report, DPIWE, Hobart.

Department of Primary Industries, Water and Environment (DPIWE) 2003b, 'Guidelines for the Issuing of Scientific Permits', unpublished report, DPIWE, Hobart.

Dixon, G 2001, 'Management Strategy for Walking Tracks and Access Corridors in Macquarie Island Nature Reserve', unpublished report, Parks and Wildlife Service.

Environment Australia (EA) 2001, *Macquarie Island Marine Park Management Plan 2001*, Department of the Environment and Heritage, Canberra.

Environment Australia (EA) 2002, *Australia's World Heritage*, Department of the Environment and Heritage, Canberra.

Evans, AJ 1970, 'Some aspects of the ecology of a calanoid copepod *Pseudoboeckella brevicaudata* Brady 1895 on a sub-Antarctic island', *ANARE Scientific Report, (B) Zoology 2*, (110): 1-100.

Falla, RA 1937, Birds, *British, Australian and New Zealand Antarctic Research Expedition (BANZARE) Reports*, Series B, Vol. 2.

Frenot, Y and Copson, GR 1995, 'Ecological restoration at subantarctic islands : Discussion and recommendations' in PR Dingwall (ed.) , *Progress in conservation of the Subantarctic Islands. Proceedings of the SCAR/IUCN Workshop on Protection, Research and Management of Subantarctic Islands*, Paimpont, France, 27-29 April, 1992, Gland, World Conservation Union.

Frey, DG 1993, 'Species of *Pleuroxus* (Anomopoda, Chydoridae) from the subantarctic islands and southernmost South America: a partial unravelling of the *Pleuroxus aduncus* problem', *Hydrobiologia* 262:146-188.

Frolich, C, Coffin, MF, Massell, C, Mann, P, Schurr, CL, Davis, SD, Jones, T, and Karner, G (submitted), 'Constraints on Macquarie Ridge tectonics provided by Harvard focal mechanisms and teleseismic earthquake locations', *Journal of Geophysical Research.*

Gales, R 1993, 'Co-operative mechanisms for the conservation of albatrosses', Report for Australian Nature Conservation Agency, Canberra.

Garnett, S (ed.) 1992, Threatened and Extinct birds of Australia, *RAOU Report* No. 82.

Goodall RNP and Galeazzi, AR 1985, 'A review of the food habits of the small cetaceans of the Antarctic and subantarctic', in WR Siefried, PR Condy, and RM Laws, (eds.) *Antarctic Nutrient Cycles and Food Webs*, Springer-Verlag. pp. 566-572.

Goscombe, B and Everard, J 1998, 'Geology of Macquarie Island', Map produced by Mineral Resources Tasmania with assistance from the Australian Antarctic Division and The Australian Antarctic Foundation.

Greenslade, PJ 1990, 'Annotated checklist of the free-living terrestrial invertebrate fauna of Macquarie Island with notes on biogeography', *Papers and Proceedings of the Royal Society of Tasmana* 124: 35-50.

Gressitt, JL 1962, 'Insects of Macquarie Island', *Pacific Insects* 4(4):905-978 (ANARE reprint B2/92), Australian Antarctic Division, Hobart.

Gressitt, JL 1967, *Entomology of Antarctica*. Antarctic Research Series 10, Australian Antarctic Division, Hobart.

Griffith, BJ and Varne, R 1980, 'The Macquarie Island ophiolite complex: mid-Tertiary oceanic lithosphere from a major ocean basin', *Chemical Geology* 30.

Harrowfield, DL 1995, *Icy Heritage – The Historic Sites of the Ross Sea Region, Antarctica*, Antarctic heritage Trust, Christchurch.

Hindell, MA 1988a, 'The diet of the king penguin *Aptenodytes patagonicus* at Macquarie Island', *Ibis*, 130: 193-203.

Hindell, MA 1988b, 'The diet of the royal penguin *Eudyptes schlegeli* at Macquarie Island', *The Emu*, 88:219-226.

Hindell, MA 1989, 'The diet of gentoo penguins *Pygoscelis papua* at Macquarie Island': Winter and early breeding season', *The Emu*, 89: 71-78.

Hindell, MA and Burton, HR 1988, 'The history of the elephant seal industry at Macquarie Island and an estimate of the pre-sealing numbers', *Papers and Proceedings of the Royal Society of Tasmania*, 122 (1): 159-176.

Hnatiuk, RJ 1993, 'Subantarctic Islands', *Flora of Australia*, 50: 53-62.

Holmes, N Giese, M and Achurch, H 2003, 'The effects of small boats and pedestrians on the numbers, distribution and behaviour of giant petrels at Sandy Bay, Macquarie Island during tourism visits, 2003', unpublished report for DPIWE, Hobart.

International Whaling Commission located at <www.iwcoffice.org/iwc.htm> updated March 2003.

Jenkin, JF, Johnstone, GW and Copson, GR 1981, 'Introduced Animal and plant species on Macquarie Island', *Colloque sur les ecosystems subantarctics*, Paimpont, C N F R A, 51: 301-313.

Jones, E 1977, 'Ecology of the feral cat *Felis catus* (L.), (Carnivorus Felidae) on Macquarie Island', *Australian Wildlife Research* 4 (4): 249-262.

Jones, E and Skira, IJ 1979, 'Breeding distribution of the great skua at Macquarie Island in relation to numbers of rabbits', *The Emu*, 79:19-23.

Jouventin, P, Bried, J and Micol, T 2003, 'Insular bird populations can be saved from rats: a long term experimental study of white-chinned petrels *Procellaria aequinoctialis* on Ile de la Possession (Crozet archipelago)', *Polar Biology* 26: 371-378.

Kantvilas, G and Seppelt, RD 1992, 'The lichen flora of Macquarie Island: introduction and an annotated checklist of species', *ANARE Research Notes* 87.

Kerr, JS 2000, *The Conservation Plan: A guide to the preparation of conservation plans for places of European cultural significance*, National Trust of Australia (NSW), Sydney.

Kiefer, KA 2002, '*Azorella selago* (Apiaceae) on subantarctic Heard Island and long term predictions for *Azorella* under a climate change scenario', School of Biological Sciences, University of Queensland. St Lucia, Brisbane.

Kirkpatrick, JB and Scott, JJ 2002. 'Change in undisturbed vegetation on the coastal slopes of subantarctic Macquarie Island, 1980-1995. *Arctic, Antarctic and Alpine Research* 34(3): 300-307.

Ledingham, R and Peterson, JA 1984, 'Raised beach deposits and the distribution of structural lineaments on Macquarie Island', *Papers and Proceedings of the Royal Society of Tasmania* 118.

Lazer, E & McGowan, A 1989, *Heard Island Archaeological Survey (1986-1987)*, Report for Australian Heritage Commission, Canberra.

Loffler, E, Sullivan, ME and Gillison, AN 1983, 'Periglacial landforms on Macquarie Island, Subantarctic Region', *Zietschrift fur Geomorphology* 27.

Mallis, M 1985, 'A qualitative investigation into scavenging of airborne sea salt over Macquarie Island', *ANARE Research Notes* 26, 1-18

Mallis, M 1988, 'A quantitative analysis of aerosol (salt) scavenging on Macquarie Island', *Papers and Proceedings of the Royal Society of Tasmania* 122, 121-128.

Mawson, D 1922, 'Macquarie Island and its future', *Papers and Proceedings of the Royal Society of Tasmania*, 192: 40-54.

Morrice, M, Bell, C, van den Hoff, J, Thiele, D, Gill, P, Paton, D and Chambellant, M 2002, 'Killer whales (*Orcinus orca*) in Australian territorial and surrounding waters – are they secure?', Paper presented at Fourth International Orca Symposium and Workshops, 2002, France.

Nash, M 2003, *Conserving Macquarie Island's Historic Heritage: Conservation Planning Guidance*. Tasmanian Heritage Office, Department of Tourism, Parks, Heritage and the Arts, Hobart.

National Oceans Office (NOO) 2001, *Snapshot of the South-east. The South-east Regional Marine Plan*, National Oceans Office, Hobart.

National Oceans Office (NOO) 2002, *Resources – Macquarie Island's Picture*, The South-east Regional Marine Plan Assessment Reports, National Oceans Office, Hobart.

National Oceans Office (NOO) 2004, *South-east Regional Marine Plan: Implementing Australia's Oceans Policy in the South-east Marine Region*, National Oceans Office, Hobart.

Norman, FI 1987, 'The ducks of Macquarie Island', *ANARE Research Notes*, 42.

Parks and Wildlife Service (PWS) 1999a, *Macquarie Island – A New Arrival. The Geological Development of a Young Island*, Department of Primary Industries, Water and Environment, Hobart.

Parks and Wildlife Service (PWS) 1999b, 'Macquarie Island Interpretation Plan', unpublished report, Department of Primary Industries, Water and Environment, Hobart.

Parks and Wildlife Service (PWS) and Nature Conservation Branch 2001, *Macquarie Island*, Department of Primary Industries, Water and Environment, Hobart.

Parks and Wildlife Service (PWS), Forestry Tasmania and Department of Primary Industries, Water and Environment 2003 et al. *Tasmanian Reserve Management Code of Practice*, Department of Tourism, Parks, Heritage and the Arts, Hobart.

Parks and Wildlife Service (PWS) 2003a, 'The Reserve Standards Framework, unpublished report, Department of Tourism, Parks, Heritage and the Arts.

Parks and Wildlife Service 2003b, 'Visitor Site Standards', unpublished report, Department of Tourism, Parks, Heritage and the Arts.

Phillips, KL, Jackson, GD and Nichols, PD 2001, 'Predation on myctophids by the squid *Moroteuthis ingens* around Macquarie and Heard Islands: stomach contents and fatty acid analyses', *Marine Ecology Progress Series* 215:179-189.

Pople, A, Simpson, RD, and Cairns, SC 1990, 'An incident of Southern Ocean oil pollution: effects of a spillage of diesel fuel on the rocky shore of Macquarie Island (Sub-antarctic) ', *Australian Journal of Marine and Freshwater Research* 41(5) 603-620

Pye, T 1993, 'Reproductive biology of the feral house mouse (*Mus musculus*) on subantarctic Macquarie Island', *Australian Wildlife Research* 20(6): 745-758.

Pye, T 2000, 'Ecology and Reproductive Biology of the Feral Black Rat (*Rattus rattus*) on subantarctic Macquarie Island', unpublished MSc thesis, University of Tasmania, Hobart.

Quilty, PGJ, Rubenach, M and Wilcoxon, JR 1973, 'Miocene ooze from Macquarie Island', *Search*, 4.

Rich, J 1996, 'Patterned quaking mire at Handspike Point, Macquarie Island', *Papers and Proceedings of the Royal Society of Tasmani*a, 130.

Robertson, GR 1986, 'Population Size and breeding success of the gentoo penguin *Pygoscelis papua* at Macquarie Island', *Australian Wildlife Research* 13(4): 583-587.

Robinson, S and Scott, JJ 1999, 'Marine Conservation at Macquarie Island 1999', unpublished report, Parks and Wildlife Service, Department of Primary Industries, Water and Environment, Hobart.

Rounsevell, DE and Brothers, NP 1984, 'The status and conservation of seabirds at Macquarie Island, in JP Croxall, Evans, PGH and Schreiber, RW (eds.), *Status and conservation of the world's seabirds*, ICBP, Cambridge.

Rounsevell, DE and Copson, GR 1982, 'Growth rate and recovery of a King Penguin, *Aptenodytes patagonicus,* population after exploitation', *Australian Journal of Wildlife Research* 9: 519-525.

Scott, JJ 1988, 'Rabbit distribution history and related land disturbance on Macquarie Island', *Papers and Proceedings of the Royal Society of Tasmania* 122(1): 255-263.

Scott, JJ 1994, *Marine Conservation at Macquarie Island*, Parks and Wildlife Service and Department of Environment, Sport and Territories, Hobart.

Scott, JJ 1996, *A Feral Cat Threat Abatement Plan for Macquarie Island*, Parks and Wildlife Service, Department of Environment and Land Management, Hobart.

Selkirk, PM, Adamson, DA and Colhuon, EA 1988, 'Terrace types and vegetation dynamics on Macquarie Island', *Papers and Proceedings of the Royal Society of Tasmania* 122 (1).

Selkirk, PM and Adamson, DA 1998, 'Structural vegetation and drainage of Macquarie Island, map', 1:25,000. Australian Antarctic Division, Hobart.

Selkirk, PM, Seppelt, RD and Selkirk, DR 1990, *Subantarctic Macquarie Island: Environment and Biology*, Cambridge University Press.

Selkirk-Bell, JM 2000, 'Geomorphic processes and environmental change on subantarctic Macquarie Island', PhD thesis, Graduate School of the Environment, Macquarie University, unpublished.

Seppelt, RD, Copson, GR and Brown, JJ 1984, 'Vascular flora and vegetation of Macquarie Island', *Tasmanian Naturalist* July: 7-11.

Shaughnessy, PD, Shaughnessy, GL and Fletcher, L 1988, 'Recovery of the fur seal population at Macquarie Island', *Papers and Proceedings of the Royal Society of Tasmani*a, 122(1): 177-187.

Shaw, JS, Hovenden, MJ & Bergstrom, DM 2005, The impact of introduced ship rates (*Rattus rattus)* on seedling recruitment and distribution of a subantartic megaherb (Pleurophyllum hookeri), *Austral Ecology* 30, 118-125.

Skira, IJ 1984, 'Breeding distribution of the Brown Skua on Macquarie Island', *The Emu* 84 4: 248-249.

Skira, IJ Brothers, NP and Copson, GR 1983, 'Establishment of the European rabbit flea *Spilopsyllus cuniculi* on Macquarie Island, Australia', *Australian Wildlife Research*, 10 (1): 121-127.

Springer, K 2001, 'Macquarie Island Nature Reserve 2000 Annual Report, unpublished report', Parks and Wildlife Service, Hobart, Tasmania.

Taylor, BW 1955, 'The flora, vegetation and soils of Macquarie Island', *ANARE Reports. B(2) No. 19, Botany*.

Taylor, RH 1979, 'How the Island Parakeet became extinct', *New Zealand Journal of Ecology*, 2: 42-45.

Tomkins, RJ 1985, 'Reproduction and mortality of Wandering Albatrosses on Macquarie Island', *The Emu*, 85:40-42.

Townrow, K 1988, 'Sealing Sites on Macquarie Island: An Archaeological Survey', *Papers and Proceedings of the Royal Society of Tasmania*, 122 (1): 15-25.

Townrow, K 1989, *Survey and Excavation of Historic Sites on Macquarie Island*, Occasional Paper No. 20, Department of Lands, Parks and Wildlife, Hobart.

Tweedie, CE and Bergstrom, DM 2000, 'A Climate Change Scenario for Surface Air Temperature at Subantarctic Macquarie Island' in W Davison, C Howard-Williams, and P Broady, (ed) *Antarctic ecosystems: models for wider ecological understanding*, New Zealand Natural Sciences, Christchurch, pp 272-281.

Tyler, PA 1972, 'Reconnaissance limnology of sub-antarctic islands I. Chemistry of lake waters from Macquarie Island and the Iles Kerguelen', *International Revue der gesamten Hydrobiologie und Hydrographie*, 57(5): 759-778.

UNESCO, no date, The MAB Program – The Statutory Framework of the World Network of Biosphere Reserves, www.unesco.org/mab/doc/statframe.htm.

Van den Hoff, J 2001, 'Further observations on the cephalopod diet of wandering albatrosses (*Diomedea exulans* L.) at Macquarie Island', *The Emu* 101:169-172.

Varne, R., Gee, RD and Quilty, PGJ 1969, 'Macquarie Island and the cause of oceanic linear magnetic anomolies', *Science*, 166.

Varne, R and Rubenach, MJ 1973, 'Geology of Macquarie Island in relation to tectonic environment' in Coleman (ed.) *The Western Pacific - Island arcs, marginal seas, geochemistry*, University of Western Australia Press.

Varne, R Brown, AV and Falloon, T 2000, 'Macquarie Island: its geology and structural history, and the timing and tectonic setting of its N-MORB to E-MORB magmatism', Dilek, Y, Moores, E, Elthon, D and Nicolas, A. Geological Society of America, Special Publication, *Ophiolites and oceanic crust: new insights from field studies and Ocean Drilling Program*, 349. 301-320.

Vincent, R 2002, Draft Cultural Heritage Assessment Report: Macquarie Island Station, Buckles Bay, Macquarie Island, unpublished report, AAD, Kingston, Tasmania.

Weimerskirch, H and Robertson, G 1994, 'Satellite tracking of light-mantled sooty albatrosses', *Polar Biology* 14: 123-126.

Whinam, J, Bergstrom, D and Chilcott, N 2002, 'Threats of alien organisms to subantarctic islands' in *Abstracts of XXV Symposium on Polar Biology*, National Institute of Polar Research, Japan.

Wouters, M & Hall, CM 1995, 'Managing Tourism in the Sub-Antarctic Islands', in Hall, CM, Johnston, ME (Eds), *Polar Tourism*, John Wiley & Sons, Chichester.

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Appendix 1 – Exploring Expeditions 1820–1930

Year	Leader and Expedition	Ship(s)	Notes
1820	Bellingshausen Russian Expedition	*Vostok* *Mirny*	Small collections made of flora and fauna.
1840	Wilkes United States Exploring Expedition	*Vincennes, Peacock, Porpoise, Sea Gull, Flying Fish*	Specimens collected but lost on return to ship.
1898	Borchgrevink British Expedition	*Southern Cross*	
1901	Scott British National Antarctic Expedition	*Discovery*	Small collection of specimens made.
1909	Shackleton British Antarctic Expedition	*Nimrod*	Specimens collected.
1911–14	Mawson Australasian Antarctic Expedition	*Aurora*	Established first scientific station on the island. Work included studies into flora, fauna and geology plus first detailed mapping of the island.
1913–15	Power (1913–14) and Tullock (1914–15 Australian Government Meteorological Expedition	*Endeavour*	Continued meteorological observations begun by Mawson's party.
1917	Shackleton Ross Sea Party	*Aurora*	
1930	Mawson British, Australian, New Zealand Antarctic Research Expedition	*Discovery*	Collections and scientific observations.

Appendix 2 – Relevant Legislation

Tasmanian Legislation Applicable to Macquarie Island Nature Reserve	
Legislation	**Responsible Agency**
Animal Welfare Act 1993	Department of Primary Industries and Water (DPIW)
Dangerous Goods (General) Regulations 1998	Department of Infrastructure, Energy and Resources (DIER)
Dangerous Goods (Road and Rail Transport) Regulations 1998	DIER
Dangerous Goods Act 1998	DIER
Environment Protection (Atmospheric Pollution) Regulations 1974	Department of Tourism, Arts and the Environment (DTAE)
Environment Protection (Noise) Regulations 1977	DTAE
Environmental Management and Pollution Control (Waste Management) Regulations 2000	DTAE
Environmental Management and Pollution Control Act 1994	DTAE
Environmental Protection (Sea Dumping) Act 1987	DTAE
Groundwater Act 1985	DPIW
Historic Cultural Heritage Act 1995	DTAE
Inland Fisheries Act 1995	DPIW
Land Use and Planning Approvals Act 1993	Department of Justice
Living Marine Resources Management Act 1995	DPIW
Mineral Resources Development Act	DIER
National Parks and Reserved Land Regulations 1999	DTAE
National Parks and Reserves Management Act 2002	DTAE
Nature Conservation Act 2002	DPIW
Plant Quarantine Act 1997	DPIW
Pollution of Waters by Oil and Noxious Substances Act 1987	DTAE
Radiation Control Act 1997	DTAE

Legislation	Responsible Agency
Radiation Control Regulations 1994 No. 237	DTAE
Sewers and Drains Act 1954	DTAE
Tasmanian Animal Health Act 1995	DPIW
Threatened Species Protection Act 1995	DPIW
Water Management Act 1999	DPIW
Weed Management Act 1999	DPIW
Whales Protection Act 1988	DPIW
Wildlife Regulations 1999	DPIW

Australian Government Legislation Applicable to Macquarie Island Nature Reserve and WHA

Legislation	Application
Quarantine Act 1908	Restricts the import of human, plant and animal samples, and waste material into Australia (including Macquarie Island Nature Reserve).
Seas and Submerged Lands Act 1973	Extends government power to the bed and subsoil beneath territorial waters, the continental shelf, and also to the recovery of minerals other than petroleum.
Australian Heritage Commission Act 1975	Establishes the Australian Heritage Commission to preserve, protect and improve the National Estate.
Historic Shipwrecks Act 1976	Protects shipwrecks and relics of historic significance.
Environment Protection (Sea Dumping) Act 1981	Regulates the dumping of waste and other matter into the sea.
Protection of the Sea (Powers of Interaction) Act 1983	Authorises the government to take measures to protect the sea from pollution by oil and other noxious substances discharged by ships.
Protection of the Sea (Prevention of Pollution from Ships) Act 1983	Prohibit ships from discharging oil and other harmful substances into the sea.
Protection of Movable Cultural Heritage Act 1986	Protects Australia's heritage of moveable cultural objects.
Hazardous Waste (Regulation of Exports and Imports) Act 1989	Provides for the regulation of the export and import of hazardous waste to ensure that such activity does not present a safety risk to human beings or the environment.
Fisheries Management Act 1991	Regulates commercial fishing operations in the Australian Fishing Zone.
Environment Protection and Biodiversity Conservation Act 1999	This act amalgamated several acts and now covers whales, threatened species, migratory species and Ramsar sites.

Appendix 3 – Vascular Flora of Macquarie Island

BLECHNACEAE
Blechnum penna-marina

DRYOPTERIDACEAE
Polystichum vestitum

GRAMMITIDACEAE
Grammitis poeppigiana

HYMENOPHYLLACEAE
Hymenophyllum falklandicum

LYCOPODIACEAE
Huperzia australiana

APIACEAE
Azorella macquariensis ..... **e**
Hydrocotyle novae-zeelandiae

ARALIACEAE
Stilbocarpa polaris

ASTERACEAE
Leptinella plumosa
Pleurophyllum hookeri

BRASSICACEAE
Cardamine corymbosa

CALLITRICHACEAE
Callitriche antarctica

CAROPHYLLACEAE
Cerastium fontanum ..... **i**
Colobanthus affinis
Colobanthus apetalus
Colobanthus muscoides
Stellaria media..... **i**
Stellaria parviflora

CRASSULACEAE
Crassula moschata

HALORAGACEAE
Myriophyllum triphyllum

ONAGRACEAE
Epilobium brunnescens
Epilobium pendunculare

POLYGONACEAE
Rumex crispus ..... **i**

PORTULACACEAE
Montia fontana

RANUNCULACEAE
Ranunculus crassipes

ROSACEAE
Acaena magellanica
Acaena minor

RUBIACEAE
Coprosma perpusilla
Gallium antarcticum

JUNCACEAE
Juncus scheuchzerioides
Luzula crinita

CYPERACEAE
Carex trifida
Isolepis aucklandica
Uncinia divaricata
Uncinia hookeri

POACEAE
Agrostis magellanica
Anthoxanthum odoratum ..... **i**
Deschampsia caespitosa
Deschampsia chapmanii
Festuca contracta
Poa annua ..... **i**
Poa cookii
Poa foliosa
Poa litorosa
Puccinellia macquariensis..... **e**

ORCHIDACEAE
Nematoceras (Corybas) dienema ..... **e**

Legend:
e – endemic species
i – introduced species

Appendix 4 – Threatened Species of Macquarie Island

Species breeding in the reserve in 2002 and listed under the *Environment Protection and Biodiversity Conservation Act 1999* [1], and/or the Tasmanian *Threatened Species Protection Act 1995* [2].

Common name	Scientific name	Status		
		In reserve	Aus[1]	Tas[2]
FAUNA **Diomedeidae (Albatrosses)**				
Wandering albatross	*Diomedea exulans exulans*	vr	V	E
Black-browed albatross	*Thalassarche melanophrys*	u		E
Grey-headed albatross	*Thalassarche chrysostoma*	u	V	E
Light-mantled sooty albatross	*Phoebetria palpebrata*	c		V
Procellariidae (Petrels and Prions)				
Southern giant petrel	*Macronectes giganteus*	c	E	V
Northern giant petrel	*Macronectes halli*	c	V	R
Cape petrel	*Daption capense*	vr		*
Grey petrel	*Procellaria cinerea*	u	*	E
Blue petrel	*Halobaena ca*erulea	u	V	V
White-headed petrel	*Pterodroma lessoni*	u		V
Soft-plumaged petrel	*Pterodroma mollis*	b? vr	V	E
Fulmar prion	*Pachyptila crassirostris*	b? vr		*
Fairy prion	*Pachyptila turtur*	vr	V	E
Oceanitidae (Storm petrels)				
Wilson's Storm Petrel	*Oceanites oceanites*	b? vr		R
Grey-backed Storm Petrel	*Oceanites nereis*	b? vr	*	*

LEGEND

b? – suspected breeding;

Species breeding:

a: abundant (> 5,000 breeding pairs);
c: common (1001–5,000 breeding pairs);
u: uncommon (51–1000 breeding pairs);
vr: (<50 breeding pairs);
wr: widespread but rare

Status: **E:** endangered; **V:** vulnerable; **R:** rare; * status needs to be reviewed

Common name	Scientific name	Status		
		In reserve	Aus[1]	Tas[2]
Phalocrocoracidae (Cormorants)				
King cormorant	*Phalocrocorax albiventer purpurascens*	u	V	V
Sternidae (Terns)				
Antarctic tern	*Sterna vittata bethunei*	vr	E	E
Macquarie Island parakeet	*Cyanoramphus novaezelandiae erythrotis*	Extinct		
Macquarie Island rail	*Rallus philippensis macquariensis*	Extinct		
Pinnipedia (Seals)				
Southern elephant seal	*Mirounga leonina*	a	V	E
Subantarctic fur seal	*Arctocephalus tropicalis*	vr	V	E
Antarctic fur seal	*Arctocephalus gazella*	u		*
New Zealand fur seal	*Arctocephalus forsteri*	vr		R
FLORA				
Dicotyledonae (the following species is rare in mainland Tasmania, but common on Macquarie Is)				
	Crassula moschata	wr		R

LEGEND

b? – suspected breeding;

Species breeding:

a: abundant (> 5,000 breeding pairs);
c: common (1001–5,000 breeding pairs);
u: uncommon (51–1000 breeding pairs);
vr: (<50 breeding pairs);
wr: widespread but rare

Status:
E: endangered; **V:** vulnerable; **R:** rare; * status needs to be reviewed

Appendix 5 – Mammals of Macquarie Island

Species breeding in the reserve in 2002 and listed under the *Environment Protection and Biodiversity Conservation Act 1999* [1], and/or the Tasmanian *Threatened Species Protection Act 1995* [2].

Common name	Scientific name	Status		
		In reserve	Aus[1]	Tas[2]
CETACEA **Mysticeti (Baleen whales)**				
Balaenopteridae				
Minke whale	*Balaenoptera acutorostrata*	rv		
Balaenidae				
Southern right whale	*Balaena glacialis*	rv st		E
Odontoceti (Toothed Whales)				
Physeteridae				
Sperm whale	*Physeter macrocephalus*	rv st		
Ziphiidae				
Southern bottlenosed whale	*Hyperoodon planifrons*	st		
Cuvier's beaked whale	*Ziphius cavirostris*	st		
Strap-toothed whale	*Mesoplodon layardii*	st		
Blainville's beaked whale	*Mesoplodon densirostris*	st		
Andrew's beaked whale	*Mesoplodon bowdoini*	st		
Delphinidae				
Long-finned pilot whale	*Globicephala melaene*	v st		
Killer whale	*Orcinus orca*	v st		
PINNIPEDIA **Otariidae**				
Antarctic fur seal	*Arctocephalus gazella*			*
Subantarctic fur seal	*Arctocephalus tropicalis*		V	E
New Zealand fur seal	*Arctocephalus forsteri*			R
New Zealand sea lion	*Phocarctos hookeri*	v		
Phocidae				
Southern elephant seal	*Mirounga leonina*		V	E
Leopard seal	*Hydrurga leptonyx*	v		
Weddell seal	*Leptonychotes weddelli*	rv		
Crabeater seal	*Lobodon carcinophagus*	rv		

LEGEND:

Status in reserve:

i	alien species	v	regular visitor	rv	rare vagrant
st	stranding recorded	x	eradicated		

Status:

E	endangered	V	vulnerable	R	rare
*	status needs to be reviewed				

All whale sightings were recorded from the island, or within 12 nautical miles.

Common name	Scientific name	Status		
		In reserve	Aus[1]	Tas[2]
Alien Mammals				
LAGOMORPHA **Leporidae**				
European rabbit	*Oryctolagus cuniculus*	i		
CARNIVORA **Felidae**				
Cat	*Felis catus*	x i		
RODENTIA **Murinae**				
Ship rat	*Rattus rattus*	i		
House mouse	*Mus musculus*	i		

LEGEND:

Status in reserve:

i	alien species	v	regular visitor	rv	rare vagrant
st	stranding recorded	x	eradicated		

Status:

E	endangered	V	vulnerable	R	rare
*	status needs to be reviewed				

All whale sightings were recorded from the island, or within 12 nautical miles.

Appendix 6 – Breeding Birds of Macquarie Island

Species breeding in the Macquarie Island Nature Reserve in 2002 and listed under the *Environment Protection and Biodiversity Conservation Act 1999* [1], and/or the Tasmanian *Threatened Species Protection Act 1995* [2].

Common name	Scientific name	Status		
		In reserve	Aus[1]	Tas[2]
Native Birds				
SPENISCIFORMES **Speniscidae (**Penguins)				
King penguin	*Aptenodytes patagonica*	a		
Gentoo penguin	*Pygoscelis papua*	c		
Royal penguin	*Eudyptes schlegeli*	a		
Rockhopper penguin	*Eudyptes chrysocome*	a		
PROCELLARIIFORMES **Diomedeidae (Albatrosses)**				
Wandering albatross	*Diomedea exulans exulans*	vr	V	E
Black-browed albatross	*Thalassarche melanophrys*	u		E
Grey-headed albatross	*Thalassarche chrysostoma*	u	V	E
Light-mantled sooty albatross	*Phoebetria palpebrata*	c		V
Procellariidae (Petrels and Prions)				
Cape petrel	*Daption capense*	vr		*
Southern giant petrel	*Macronectes giganteus*	c	E	V
Northern giant petrel	*Macronectes halli*	c	V	R
Grey petrel	*Procellaria cinerea*	u		
Blue petrel	*Halobaena caerulea*	u	V	V
White-headed petrel	*Pterodroma lessoni*	u		V
Soft-plumaged petrel	*Pterodroma mollis*	b? vr	V	E
Fulmar prion	*Pachyptila crassirostris*	b? vr		
Antarctic prion	*Pachyptila desolata*	a		
Fairy prion	*Pachyptila turtur*	vr	V	E
Sooty shearwater	*Puffinus griseus*	u		
Oceanitidae (Storm petrels)				
Wilson's storm petrel	*Oceanites oceanites*	vr	R	
Grey-backed storm petrel	*Oceanites nereis*	b? vr		

LEGEND

b? – suspected breeding;

Species breeding:

a: abundant (> 5,000 breeding pairs);
c: common (1001–5,000 breeding pairs);
u: uncommon (51–1000 breeding pairs);
vr: (<50 breeding pairs);

Status:
E: endangered; **V:** vulnerable; **R:** rare; * status needs to be reviewed

Species breeding in the Macquarie Island Nature Reserve in 2002 and listed under the *Environment Protection and Biodiversity Conservation Act 1999* [1], and/or the Tasmanian *Threatened Species Protection Act 1995* [2].

Common name	Scientific name	Status		
		In reserve	Aus[1]	Tas[2]
Pelcanoidae (Diving petrels)				
Common diving petrel	*Pelecanoides urinatrix*	vr		
PELECANIFORMES **Phalocrocoracidae (Cormorants)**				
King cormorant	*Phalocrocorax albiventer purpurascens*	c	V	V
ANSERIFORMES **Anatidae (Ducks)**				
Black duck	*Anas superciliosa superciliosa*	u		
CHARADRIFORMES				
Stercorariidae (Skuas)				
Subantarctic skua	*Catharacta lonnbergi*	c		
Laridae (Gulls)				
Kelp gull	*Larus dominicanus*	u		
Sternidae (Terns)				
Antarctic tern	*Sterna vittata bethunei*	vr	E	E
Alien birds				
ANSERIFORMES **Anatidae (Ducks)**				
Mallard	*Anas platyrhynchos platyrhynchos*			
PASSERIFORMES **Fringillidae (Finches)**				
Redpoll	*Carduelis flammea*	c		
Sturnidae (Starlings)				
Common starling	*Sturnus vulgaris*	c		
Extinct Native Birds				
Macquarie Island parakeet	*Cyanoramphus novaezelandiae erythrotis*	Extinct		
Macquarie Island rail	*Rallus philippensis macquariensis*	Extinct		
Extinct Introduced Birds				
Weka		Extinct		

LEGEND

b? – suspected breeding;

Species breeding:

a: abundant (> 5,000 breeding pairs); **c:** common (1001–5,000 breeding pairs);
u: uncommon (51–1000 breeding pairs); **vr:** (<50 breeding pairs);

Status:
E: endangered; **V:** vulnerable; **R:** rare; * status needs to be reviewed

Appendix 7 – Statements of Significance for Historic Sites

Conserving Macquarie Island's Historic Heritage – Excerpts from Nash (2003)

6.0 STATEMENT OF SIGNIFICANCE

6.1 Discussion of Significance

As a result of the historical research by Cumpston (1968) and archaeological work by Townrow (1989) the historic cultural resources of Macquarie Island are amongst the best documented of any on the subantarctic and Antarctic islands. Other areas for which limited historical and archaeological research has been carried out include Prince Edward and Marion Island (Cooper & Avery 1986), Heard Island (Lazer & McGowan 1989) and the islands of the Ross Sea (Harrowfield 1995). While a number of Subantarctic Islands are protected for conservation purposes, Macquarie Island is the only reserve which includes specific legislative protection relating to historic sites (Wouters & Hall 1995).

The physical remains of the sealing and oiling operations at Macquarie Island are the result of the commercial sealing industry which began in the Southern Oceans in 1775 and continued as late as the 1960s at locations such as Kerguelen Island and South Georgia. The products obtained from seals were the first viable export to be shipped from the Australian colonies and these profits provided local merchants with the capital for investment in a range of other commercial activities. The sealing industry often preceded official exploration and settlement; private enterprise rather than the colonial government initiated the occupation of Macquarie Island. The island's heritage places provide valuable insights into the lives of the men who endured months of isolation and harsh conditions to eke a meagre living from the island's natural resources. These places are also an important record of changing technologies, social conditions and trading patterns in the history of Australasia.

The early production of seal oil at Macquarie Island was based on the use of try-works technology. Intact examples of land-based try works from the late 18th and early 19th centuries are rare in Australia and in the Southern Hemisphere in general. The processing areas at Bauer Bay and Sandy Bay and the try works at Caroline Cove, Hurd Point and Lusitania Bay are some of the most complete examples of their type known to exist in Australia and are therefore of considerable archaeological significance. The Hurd Point site in particular contains elements that encompass all periods of Macquarie Island's history and is of exceptional significance at a national level.

The period of occupation by New Zealand entrepreneur Joseph Hatch, from the late 1880s to 1919, saw greater capital investment in the island and the introduction of more advanced technology. Much of the archaeological evidence visible today, including the prominent remains of five steam digester plants, dates from this era. The introduction of this technology on Macquarie Island in 1889 was paralleled by its first usage for oiling by the Norwegian whaling fleet in the same year. It must therefore be considered as 'state of the art' and reflects the rapid changes in the industrial technology that was available in the Australasian colonies.

The use of steam digesters in the production of oil from seals and penguins appears to have been first introduced at Macquarie Island and was not followed elsewhere in the sub-Antarctic until 1908 at Kerguelen Island and 1909 at South Georgia Island. Both these later operations relied on large-scale plant equipment primarily established for the processing of whale carcasses. The existing remains at Macquarie Island are therefore representative of a rare technological usage. Steam digester plants were located at the Nuggets, the Isthmus, Hurd Point, Lusitania Bay and Hasselborough Bay. All sites, with the exception of Hasselborough Bay, have associated domestic quarters that mostly survive as sub-surface deposits. The Nuggets site was the headquarters of operations at Macquarie Island from 1892 until 1919 and has the most intact industrial and domestic elements from this final phase of oil procurement. The evidence from this site is exceptional in both the Australian and international contexts.

The oiling industry was eventually ended by the conservation efforts of scientists who had been based at Macquarie Island during 1911 to 1915. The physical remains associated with early scientific endeavours are limited to sealers huts at Lusitania Bay and Hurd Point that were periodically used during field trips, and the former wireless station on Wireless Hill. This station facilitated the first radio communication between Antarctica and Australia and was the first such facility established in the region. The wireless station was also associated with the first long-term meteorological station established in the Antarctic/subantarctic region. The site is significant for its links with the initial Australian scientific expeditions to the Antarctic/subantarctic led by Douglas Mawson in 1911–1914. These early expeditions were important in the development of a permanent role for Australia in the region and its subsequent claims to a large portion of the Antarctic continent.

Permanent scientific involvement at Macquarie Island dates from the establishment of the first ANARE base in 1948. The base is the oldest continually occupied Australian station and one of the oldest in the Antarctic region. The establishment of ANARE was a major projection of Australia nationalism into Antarctica and contributed to Australia's major role in the formulation of protocols that guide all current international activities in the region. While none of the original buildings at the ANARE base survive, the two field huts remaining at Sandy Bay and Lusitania are representative of this earliest ANARE occupation. The huts have been in continual use until quite recently (1993 and 1996) and are representative of the history of ANARE research and field operations on the island. They have particularly close associations for many expeditioners who have lived and worked at Macquarie Island. These huts and a number of the sealing sites mentioned above also have considerable potential for educational and interpretive activities at a number of different levels.

6.2 Statements of Significance

The criteria used in the assessment of the significance of the historic cultural resources of Macquarie Island are those used by the Tasmanian Heritage Council and by the Australian Heritage Commission. The criteria are set out in Section 16 of the *Historic Cultural Heritage Act 1995* and in Section 4 of the *Australian Heritage Commission Act 1975*. The following statements outline the significance criteria for each site followed by a brief summary of the place and its level of significance on a state and national basis. See Map 4 of the Management Plan for location of these sites.

1. Wireless Hill Station

Tasmanian Heritage Council – Criteria G and E
Australian Heritage Commission – Criteria H and F

The wireless station on Wireless Hill facilitated the first radio communication between Antarctica and Australia during the 1911–1913 AAE and was the first wireless station established in the Antarctic sub-Antarctic region. The station was also associated with the first long-term meteorological station established in the region. The site has limited physical evidence from its short occupation period. The site is of considerable state and national significance for its association with Sir Douglas Mawson and the pioneering scientific work of the AAE.

2. The Isthmus Processing Works

Tasmanian Heritage Council – Criteria B, C and E
Australian Heritage Commission – Criteria B, C and F

The Razorback Hill site dates from the later period of oiling at Macquarie Island and was used seasonally (1892–1919) in conjunction with the Nuggets works. The site has considerable physical evidence including elements of the digester plant and the sub-surface remains of accommodation and storage huts. The site is of considerable state and some national significance as it demonstrates a rare aspect of Tasmania's heritage and has the potential to yield information that will contribute to an understanding of Tasmania's history.

3. Hasselborough Bay Processing Works

Tasmanian Heritage Council – Criteria B, C and E
Australian Heritage Commission – Criteria B, C and F

The Hasselborough Bay site dates from the later period of oiling at Macquarie Island (1917–1919) and was

used seasonally in conjunction with the nearby Razorback Hill works. The site has limited physical evidence and consists of elements of a single digester plant. The site is of considerable state and some national significance as it demonstrates a rare aspect of Tasmania's heritage and has the potential to yield information that will contribute to an understanding of Tasmania's history.

4. The Nuggets Processing Works
Tasmanian Heritage Council – Criteria B, C, D and E
Australian Heritage Commission – Criteria B, C, D and F

The Nuggets site dates (1891–1919) from the later period of oiling at Macquarie Island and was the headquarters of Joseph Hatch's operations on the island. The site is the most intact and representative from this period of occupation and contains graves, sub-surface hut remains, a large digester plant and extensive artefact scatters. The site is of exceptional state and national significance as it demonstrates a rare aspect of Australia's heritage. It also has the potential to yield information that will contribute to an understanding of Australia's history, is important in demonstrating principal characteristics of a class of cultural places, and is important in demonstrating a high degree of technical achievement.

5. Bauer Bay Processing Works
Tasmanian Heritage Council – Criteria C and E
Australian Heritage Commission – Criteria C and F

The Bauer Bay site was used seasonally (1878–1879) during the revival of oiling operations at Macquarie Island after the lapse period. The site has limited surviving sub surface evidence. The site is of some state and national significance, as it has the potential to yield information that will contribute to an understanding of Tasmania's history.

6. Sandy Bay Hut
Tasmanian Heritage Council – Criteria B and F
Australian Heritage Commission – Criteria B and G

The Sandy Bay hut was built in 1949 to accommodate ANARE fieldwork parties. It was in continual use until 1996 and is still in its original configuration with some minor additions. The site is of considerable state and some national significance as it demonstrates a rare aspect of Tasmania's history and it has strong or special meaning for a group or community because of its social and cultural associations.

7. Sandy Bay Processing Works
Tasmanian Heritage Council – Criteria B, C and E
Australian Heritage Commission – Criteria B, C and F

The Sandy Bay site was one of the first locations on Macquarie Island where try works and accommodation areas were established. The site was in operation from 1812 to 1820 and was subsequently reused by various sealing parties in 1851, 1877–1878 and during the Hatch period. Members of the AAE during the 1911–1913 expedition reused a hut on the site. The site is of considerable state and some national significance as it demonstrates a rare aspect of Tasmania's heritage and has the potential to yield information that will contribute to an understanding of Tasmania's history.

8. Lusitania Bay Processing Works
Tasmanian Heritage Council - Criteria B, C and E
Australian Heritage Commission - Criteria B, C and F

The Lusitania Bay site was used sporadically for oiling operations between the 1820s and 1899, and was the first location where digester technology was introduced to Macquarie Island. Members of the AAE during the 1911–1913 expedition also reused the site. The site has considerable physical evidence from all periods of occupation including the remains of an early try works, elements of the later digester plant and the sub-surface remains of associated accommodation huts. The site is of considerable state and some national significance as it demonstrates a rare aspect of Tasmania's heritage and has the potential to yield information that will contribute to an understanding of Tasmania's history.

9. Lusitania Bay Hut
Tasmanian Heritage Council – Criteria B and F
Australian Heritage Commission – Criteria B and G

The Lusitania Bay hut was built in 1950 to accommodate ANARE fieldwork parties. It was in continual use until 1993 and is still in its original configuration with some minor additions. The site is of considerable state and some national significance as it demonstrates a rare aspect of Tasmania's history and it has strong or special meaning for a group or community because of its social and cultural associations.

10. Caroline Cove Processing Works
Tasmania Heritage Council – Criteria B, C, and E
Australian Heritage Commission – Criteria B, C and F

The Caroline Cove site was the most intensively used location on Macquarie Island's west coast and dates to a single occupation from 1823 to 1827. The site has physical evidence from this period in the form of a try works and associated artefact scatters. The site is of considerable state and some national significance as it demonstrates a rare aspect of Tasmania's heritage and has the potential to yield information that will contribute to an understanding of Tasmania's history.

11. Hurd Point Processing Works
Tasmanian Heritage Council – Criteria B, C and E
Australian Heritage Commission – Criteria B, C and F

The Hurd Point site was sporadically used for oiling operations between the 1820s and 1899 and was occasionally occupied by members of the AAE during the 1911–1913 expedition. The site has considerable physical evidence from all periods of occupation including the largest and best preserved try-works on the island, elements of the later digester plant and the well preserved sub-surface remains of at least one accommodation hut. The site is of exceptional state and national significance as it demonstrates a rare aspect of Australia's heritage and has the potential to yield information that will contribute to an understanding of Australia's history. The remoteness of the site and its rugged setting on the margin of Macquarie Island's largest penguin rookery also contribute to its significance.

Appendix 8 – Memorandum of Understanding for Marine Protected Areas

Service Level Agreement

between

the Director of National Parks (Commonwealth)

and

The Crown in Right of Tasmania represented by the Department of Tourism, Parks, Heritage and the Arts (Tasmania)

for the

Cooperative Management of Marine Parks

This SERVICE LEVEL AGREEMENT is made on the

...11th... day of .JANUARY. 2004/5

BETWEEN

The DIRECTOR OF NATIONAL PARKS (Commonwealth) ("Director")

AND

THE CROWN IN RIGHT OF TASMANIA represented by the DEPARTMENT OF TOURISM, PARKS, HERITAGE AND THE ARTS, TASMANIA ("State")

This Service Level Agreement refers only to the cooperative arrangements to be applied by the above agencies to marine parks in Commonwealth and State and Territory waters either adjoining or in proximity of each other.

WHEREAS

A. The Director of National Parks is a corporation under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth);

B. the functions of the Director of National Parks include:
   (a) to administer, manage and control Commonwealth reserves; and
   (b) to protect, conserve and manage biodiversity and heritage in Commonwealth reserves; and
   (d) to provide, and assist in the provision of, training in the knowledge and skills relevant to the establishment and management of national parks and nature reserves; and
   (e) to carry out alone or in cooperation with other institutions and persons, and to arrange for any other institution or person to carry out, research and investigations relevant to the establishment and management of Commonwealth reserves; and
   (f) to make recommendations to the Minister in relation to the establishment and management of Commonwealth reserves.

C. The Director may perform any of the Director's functions in cooperation with a State, a self-governing Territory or an agency of a State or self-governing Territory.

D. The Director may delegate all or any of the Director's powers or functions to a person.

E. In relation to the marine environment the State, either itself or through its officers administers the *National Parks and Reserves Management Act 2002*, the *Nature Conservation Act 2002 and* the *Living Marine Resources Management Act 1995.*

F. The parties enter into this SLA to record agreed principles by which they will seek to co-operatively manage issues to do with the regulation of marine parks.

IT IS HEREBY AGREED AS FOLLOWS:

1 INTERPRETATION

1.1 In this Service Level Agreement:

"Annual Business Agreement" means an Annual Business Agreement that may be made pursuant to this SLA;

"CEO" means Director;

"compliance" includes education and enforcement activities;

"cooperative management" means management of a marine park in a manner which ensures that, to the greatest extent practicable, regulatory, planning, enforcement and operational activities undertaken in the State/NT and Commonwealth components of the marine park are complementary and are executed in accordance with compatible goals and objectives;

"Director" means the statutory office of the Director of National Parks established under section 514 of the *Environment Protection and Biodiversity Conservation Act 1999* of the Commonwealth;

"marine park" means an area of sea (including any seabed) that is established as a Commonwealth reserve under the *Environment Protection and Biodiversity Conservation Act 1999* or as a marine conservation reserve under the *Nature Conservation Act 2002*;

"SLA" means this Service Level Agreement and any Schedule or Business Agreement that may be made pursuant to it;

"Schedule" means a Schedule that may be attached to this SLA, that is agreed between the Director and the State that sets out matters pertaining to the cooperative/ coordinated management of a particular marine park;

"State" means the Crown in Right of Tasmania and includes Ministers, statutory and other officers;

"State agency" means the Department of Tourism, Parks, Heritage and the Arts Tasmania;

Reference to the Director includes any statutory successor to the functions of the Director;

Reference to the Department of Tourism, Parks, Heritage and the Arts Tasmania includes reference to any agency succeeding or replacing the Department of Tourism, Parks, Heritage and the Arts Tasmania;

Reference to the *Environment Protection and Biodiversity Conservation Act 1999* or the *Nature Conservation Act 2002, the National Parks and Reserves Management Act 2002, or the Living Marine Resources Management Act 1995* includes reference to any legislation which amends, repeals or replaces those Acts.

2. SERVICE LEVEL AGREEMENT

2.1 This SLA is not intended to give rise to any legally enforceable rights or obligations between the parties, and places no limitations on the performance of functions and exercise of powers of the Director or the State under relevant Commonwealth and State laws or otherwise.

2.2 This SLA applies only to arrangements for the cooperative management of marine parks. While enhancements to planning functions and processes may arise through the cooperative application of the provisions of this SLA, nothing in the SLA should be taken to require any amendment to existing State or Commonwealth planning functions and processes.

3. PURPOSE

3.1 The purpose of this SLA is to establish the principles of partnership between the Commonwealth and the State, for the:

1. cooperative management and planning of marine parks; and

2. development and implementation of arrangements specific to individual marine parks as required and set out in Schedules and Annual Business Agreements to this SLA.

4. MUTUAL RECOGNITION OF LEGAL INSTRUMENTS

4.1 The parties agree to develop and put in place measures to allow each party and its agents to implement relevant laws (including regulations, by-laws and other legal instruments) of the other party in areas of marine parks.

4.2 The parties recognise that the particular measures undertaken may vary between marine parks according to varying circumstances. The parties accordingly agree to undertake the measures appropriate to each marine park, as set out in any Schedules and Annual Business Agreements that may be agreed under this SLA.

4.3 Without limiting their generality these measures may include cross-authorisation of staff of agencies from each jurisdiction, and delegation of enforcement and other powers.

5. CONFLICT RESOLUTION

5.1 In the event that conflict arises, the parties agree that without delay and in good faith they will attempt to resolve any dispute or difference that arises in relation to any matter under this SLA. If the parties cannot come to an agreement regarding any dispute the party claiming that a dispute has arisen must notify the other parties giving details of the dispute. Following this notification the matter will be referred to the relevant CEO of each party to the SLA for further negotiation and agreement.

5.2 In the event of any conflict between the terms and conditions contained in this SLA, and terms and conditions specific to the Schedules and Annual Business Agreements, where required, to the SLA, the order of precedence among the documents shall be as follows:

1. the SLA;
2. the Schedules; and
3. the Annual Business Agreements.

5.3 Each of the parties will notify and consult on matters that come to their attention that may affect the SLA.

6. ACTIONS AGREED BY THE PARTICIPANTS

6.1 The parties agree to:

1. undertake marine park management and planning in a manner consistent with the terms of this SLA;
2. cooperate and consult in the implementation of specific marine park management, planning and operational initiatives, as set out in the SLA and where agreed, associated Schedules and Annual Business Agreements;
3. promote integration across government agencies and departments within their jurisdiction;
4. undertake consultation with the community on marine park management and planning issues;
5. where agreed, make a financial commitment, in cash or in kind, to implementing, if developed, the Schedules and Annual Business Agreements to this SLA; and
6. implement their commitments for delivering the National Representative System of Marine Protected Areas (NRSMPA).

7. OPERATIONAL AND RESOURCING ARRANGEMENTS

7.1 The parties agree that where operational and resourcing arrangements are required, arrangements developed and put in place will promote complementary approaches to planning, law enforcement and management.

7.2 The parties recognise that where operational and resourcing arrangements are required, arrangements will vary between marine parks according to circumstances. The parties accordingly agree to develop and implement operational and resourcing arrangements, where required, that are appropriate to particular marine parks, as necessary.

7.3 Without limiting their generality, operational and resourcing arrangements may include the following activities and initiatives:

1. sharing of equipment, infrastructure costs, staffing, and other resources;
2. cooperation in conduct of compliance activities;
3. joint development of communication and education programs to avoid duplication of efforts and costs;
4. providing a focal point for management liaison with, and coordination of, other government agency activities (eg. Defence activities, Coastwatch liaison);
5. development of coordinated monitoring, research and management activities, including the sharing of data; and
6. delegation of management responsibilities from one party to another.

7.4 The parties further agree that any operational and resourcing arrangements that are put in place under an Annual Business Agreement shall include appropriate performance criteria and assessment against these criteria in the conduct of the arrangements.

8. IMPLEMENTATION ARRANGEMENTS

8.1 Liaison officers will be nominated by each party to represent the parties in discussions on matters pertaining to this SLA and its Schedules and Annual Business Agreements. Each party will advise the other of the contact details for the liaison officers so appointed, as soon as practicable after this SLA comes into force. Each party will advise the other of any changes to the contact details.

8.2 To the extent that any management committees are established to oversight marine park planning and management, each party should be entitled to appoint a representative to the committee.

9. SCHEDULES

9.1 The parties recognise that the varying circumstances of individual marine parks require separate consideration of the appropriate management arrangements that should apply at each. To this end, the parties may agree to develop, where required, Schedules to this SLA that detail the management, operational and resourcing arrangements in terms consistent with this SLA, that will apply to the areas so identified. Upon the satisfactory conclusion of the negotiation of a Schedule, the liaison officers will submit the Schedule to the parties for their agreement that shall be given in writing.

9.2 The parties further recognise that additional marine parks may be established during the term of this SLA and hereby agree to develop, where required, Schedules pertaining to any such marine parks, in terms consistent with provisions of this SLA, as soon as practicable following establishment.

9.3 A Schedule may include provisions for renegotiation of its terms, including the period of time for which the Schedule will have effect.

10. FINANCIAL ARRANGEMENTS

10.1 Where financial arrangements are entered into by the parties to support cooperative management of marine parks, the parties agree that such arrangements will be explicit and transparent and reflect the responsibilities of each party for marine park management.

10.2 The parties recognise that details of particular financial arrangements adopted may vary between marine parks according to varying circumstances.

10.3 An Annual Business Agreement will be an annual attachment to a Schedule (developed where required) and will provide information supporting the financial arrangement, work to be undertaken, and performance outcomes. The parties will agree in the development of the Annual Business Agreement on the type of costs and on the level of contribution each party will make.

10.4 Financial arrangements may be negotiated on the basis of various factors, including:

1. the relative area of each jurisdiction;
2. the intensity of management activity in each jurisdiction and corresponding compliance effort;
3. staff involvement;
4. in-kind or other contributions; and
5. project-based cost sharing.

10.5 The parties accordingly agree to agree, implement and review any financial arrangements appropriate to individual marine parks through Schedules and Annual Business Agreements, developed where required, pursuant to this SLA. The provision of funding by the Commonwealth is subject to the terms of Schedules and Annual Business Agreements to this SLA being met.

10.6 The parties agree to acquit funds on an annual basis in accordance with the arrangements set out, where required, in the Annual Business Agreement.

10.7 Without limiting their generality, these arrangements may include establishment of a management fund to which agencies from both jurisdictions contribute and access upon such conditions as are agreed between the parties; reimbursement of the costs incurred by agencies of one jurisdiction while undertaking agreed activities on behalf of agencies of the other jurisdiction; and the transfer of funds from one jurisdiction to the other, upon such conditions as are agreed by the parties.

11. COMPLIANCE

11.1 The parties agree that effective compliance activities are necessary to encourage public awareness, support and protection of the values of marine parks. The parties recognise the advantages of developing and implementing cooperative compliance through the sharing of resources, skills and information. Financial and operational arrangements for compliance will be set out, where required, in Schedules and Annual Business Agreements pursuant to this SLA.

12. PROMOTION OF JOINTLY MANAGED ACTIVITIES

12.1 The parties agree to acknowledge their respective roles and to consult on all communications and education planning and development, and key correspondence concerning cooperatively managed work programs. This includes providing opportunities for joint projects.

12.2 The participants agree that in all circumstances where management programs receive Commonwealth and/or State funds under a Schedule, where required, to this SLA, appropriate acknowledgment will be given to each party as a source of those funds.

12.3 Specifically, in addition to recognising its own contribution, each party will give recognition to the other party's contributions to projects and ensure that:

1. any communication/education/marketing tool planned and prepared as part of the management of the marine park or reserve will acknowledge its origin under the cooperative management arrangement and reference to the State and/or Commonwealth financial support. A copy of any such publication is to be provided to the other party or parties; and

2. each party's role and the relevant cooperatively managed program is acknowledged at relevant forums, conferences and at project openings.

12.4 The parties agree to consult on funding announcements.

13. SCIENTIFIC RESEARCH AND MONITORING

13.1 The parties recognise that targeted scientific research and monitoring are important tools in the effective management of marine parks. The parties hereby agree to cooperate in the conduct of relevant research and monitoring, the sharing of data and the application of research findings to marine park management, subject to financial and operational arrangements as set out in Schedules and Annual Business Agreements, which may be agreed pursuant to this SLA.

13.2 The parties agree that a broad ecological planning framework, within which more detailed information on ecosystems, communities and species distributions can be organised, is the most effective basis on which to identify and plan marine parks in recognition of the goals of the National Representative System of Marine Protected Areas.

14. TRAINING

14.1 The parties recognise that provision of training opportunities for staff is necessary to ensure the effective management of marine parks. The parties further recognise that there can be considerable advantages, including but not restricted to cost advantages, to be gained by agencies from both jurisdictions through the sharing of management skills and through the adoption of joint approaches to the development of new skills through provision of training opportunities. The parties hereby agree to cooperate in the provision of relevant training opportunities to staff of their relevant agencies, as set out in Schedules and Annual Business Agreements which may be agreed pursuant to this SLA.

15. STAKEHOLDER RELATIONS

15.1 The parties recognise that effective management of marine parks requires the involvement of commercial users and community interest groups that are affected by decisions about marine parks. Accordingly, the parties will support and promote appropriate processes, practices and programs which provide avenues for consultation with and active involvement of commercial users, community, groups and other stakeholders on matters pertaining to planning for and the management of marine parks.

16. TERM OF AGREEMENT AND AMENDMENTS TO AGREEMENT

16.1 This SLA will enter into force upon the date of signature of the second of the signatories to the SLA.

16.2 This SLA will remain in force until concluded, amended or terminated as provided hereafter.

16.3 After the SLA has been in force for five years it will be reviewed by the parties who will determine together whether it is to be terminated, amended or continue in force on the terms set out herein.

16.4 Either party may propose amendments to this SLA (including its Schedules and Annual Business Agreements) at any time provided such amendments are proposed to the other parties in writing. The terms of any amendments shall be negotiated by the appointed liaison officers by such means as they determine before being submitted to all parties for their agreement.

16.5 Either party may terminate this SLA at any time on six months notification being given in writing to the other parties.

IN WITNESS WHEREOF the parties have executed this Service Level Agreement as at the day and year first written above.

Signed by the Director of National Parks
Parks Australia South
Department of the Environment and Heritage

.....
Delegate of the Director of National Parks

On this date ..11../1../..05

In the presence of (insert full name and office of witness below)

.....

...LOUISE OLIVER.....

On this date ..11../01/..05

Signed for the Crown in Right of Tasmania represented by the Department of Tourism, Parks, Heritage and the Arts Tasmania by the Director of National Parks and Wildlife

.....
Director of National Parks and Wildlife

On this date ...../ /.....

In the presence of (insert full name and office of witness below)

.....Heidi Jones.....
.....Executive Secretary.....

Appendix 9 – Implementation Schedule

This implementation schedule lists the major actions in the management plan, responsibility for their implementation and their priority. The schedule can then be used to periodically evaluate and monitor implementation of the plan, and to evaluate and monitor management of the reserve.

Major Plan Actions	
Plan Ref	**Action Summary**
	Values
5.2	Prepare a geoconservation management strategy that identifies sites of geoconservation significance, maps locations accurately and provides management recommendations
5.6 & 6.16.3	Prepare and or implement management programs to rare plant species, and liaise with DPIW in regard to the development of a response plan for plant disease in the reserve.
5.8	Set priorities for threatened species management, having regard to international and national priorities, recovery plans, action plans and threat abatement plans.
5.9	As a matter of the highest priority, prepare and implement a comprehensive rabbit, rat and mouse eradication program. Until such time as a combined rabbit and rodent eradication program can be undertaken, continue rabbit control as a high priority, using *myxoma* virus and the most effective available methods.
	Historic Heritage
5.10	Nominate the 11 significant historic places on Macquarie Island for inclusion on the Tasmanian Heritage Register under the Tasmanian *Historic Cultural Heritage Act 1995*, and consider nomination of the 11 significant historic places on Macquarie Island to the new Commonwealth National Heritage List as one of the earliest industrial sites in Australia.
5.10	Liaise with the AAD and the Queen Victoria Museum in regard to conservation of historic cultural artefacts on the station.
	Tracks & Structures
6.10 & 6.2.2	Undertake track management works indicated in Dixon (2001) required to: meet Australian Standards for occupational health and safety and for tourist access; and progressively replace all wooden track markers and directional signs on the Class 5 track network with more robust and low maintenance markers.
6.2.2	Promote and support the removal of fixed antennas, aerials and guy wires at field huts and their replacement with whip antennas or other appropriate facilities to reduce bird strike incidents.

	Marine Issues
6.2.3 & 8.1	Prepare and implement a Memorandum of Understanding regarding cooperative management of the state waters to 3 nm, the Territorial Sea and WHA waters to 12 nm and the Macquarie Island Marine Park.
6.13 & 6.2.3	Record, collect and return to station marine debris (where reasonably practical) for incineration or removal from the reserve.
	Educational Tourism
6.2.5	Replace commercial educational tourism infrastructure as necessary to meet Australian Standards, to ensure visitor safety and to ensure environmental protection.
6.2.5 & 6.5.3	Monitor commercial educational tourism activity at the three TMAs to determine cumulative impacts on the cultural and natural heritage values of the sites and for the presence of new alien species.
	Quarantine
6.6 & 6.9	Develop cooperative and complementary commercial educational tourism guidelines, quarantine and tourism management practices where tourist vessels visit other subantarctic or similar environments prior to arrival at Macquarie Island, and identify, clean and/or remove likely contamination points where species may adhere to vessels, cargo and people and be transported to the island.
	Research & Monitoring
6.7 & 6.8	Liaise with DPIW in regard to guidelines and criteria for assessment, prioritisation, monitoring and evaluation of research to be conducted in the reserve based on the research and management priorities identified in Table 3.
6.8	Encourage international and national research programs that directly contribute to conservation outcomes specified in recovery plans for threatened species.
	Australian Antarctic Division
6.12	The Director will commence discussions with the Australian government in regard to concluding a formal agreement between the State and Australian Governments as soon as practicable to give effect to the provisions of this section of the management plan.
6.13	Monitor old tip site for exposure of rubbish such as metal objects that have the potential to injure moulting elephant seals, and remove them where possible, and liaise with AAD in regard to testing and clean-up operations that may be necessary should heavy metal contamination be evident at the old tip site.
6.16.2	Liaise with the Secretary and AAD in regard to the development of an appropriate oil spill response plan for the reserve.
	Other Issues
7.2	Review the Macquarie Island Interpretation Plan (PWS 1999) in 2008.
7.3	Develop a range of mechanisms and opportunities for consulting with people interested in protection, conservation, and management of the reserve.

Appendix 10 – Monitoring of Key Indicators and Management Performance

Key indicators provide a guide for evaluating how successfully the management plan has been implemented, and whether progress has been made toward the achievement of the management objectives. More detailed research and monitoring programs, policies or procedures approved by the Director may be applied to evaluation of this plan and its implementation.

The following are the key desired outcomes identified in Section 4.2 of this management plan. The key indicators to be used for monitoring and evaluating this plan will be developed from these key desired outcomes. Some examples of key indicators are given below; more detailed key indicators can be derived from the actions given in this plan, or they will be developed through the consultation processes identified in Section 7 of this plan.

KDO 1: The World Heritage values of the reserve are identified, protected, conserved and, where necessary, rehabilitated.

Some general key indicators are:

- The statements of significance in the World Heritage nomination have been reviewed and assessed for accuracy and authenticity.
- Identification of outstanding values of World Heritage significance that meet further criteria for World Heritage listing have been identified based on new knowledge or changing circumstances.
- State of the Macquarie Island World Heritage Area reporting has been carried out in accordance with requirements and is publicly available.
- The nature and level of feedback about the management of the reserve from individuals, research scientists, management staff, ecotourism operators, committees, forums and other authorities with interests in WHA management.

KDO 2: The natural and historic heritage values of the reserve are protected, conserved and managed.

Some key indicators are:

- The number of high and medium priority actions of Section 5 of this management plan that have been implemented or are being implemented.
- The degree of compliance with the zoning established in this plan and compliance with the requirements for management of Special Management Areas.

- Maintenance and management of historic cultural heritage sites is being undertaken according to conservation plans developed by cultural heritage specialists.

KDO 3: The reserve conserves biodiversity and negative conservation trends for threatened species are being reversed.

Some key indicators are:

- The number of relevant actions identified in national recovery plans, threat abatement plans and action plans that are being implemented in the reserve.
- Monitoring and research shows no further decline in the threatened fauna species of the reserve.
- Monitoring and research programs show that vegetation communities and fauna species are recovering from the impacts of alien species.
- Monitoring and research programs show that burrow-nesting seabird species exhibit a sustained increase in population sizes.

KDO 4: A program (or programs) to eradicate rabbits, rats and mice from the reserve has been planned, funded and implemented.

A key indicator is:

- Ideally, the rabbit, rat and mouse populations have been successfully eradicated.

KDO 5: Quarantine and environmental protection measures are effective and thoroughly applied, and have successfully prevented further introductions of alien species.

Some key indicators are:

- No further alien introductions have been identified.
- If new alien species have arrived in the reserve, they have been successfully eradicated.
- All visitors to the reserve are thoroughly educated in quarantine and environmental protection measures, and these measures are undertaken as a matter of course.

KDO 6: Those ecological processes and systems affected by direct or indirect human disturbance, particularly due to introductions of alien species, are recovering their natural integrity.

Some key indicators are:

- Breeding populations of seabirds, particularly threatened species, are recovering.
- Walking tracks, old hut sites and other disturbed sites have recovered through natural means without further intervention.

- Rehabilitation, where necessary, is simple, cost-effective and working.

KDO 7: Human impacts resulting from commercial educational tourism, scientific and management programs are controlled and do not threaten the natural or historic heritage values of the reserve.

Some key indicators are:

- Monitoring and reporting show high compliance with the policies, guidelines and conditions in this plan, access authorities and scientific permits.
- Rubbish and sewage disposal methods at the station meet current environmental standards.
- Monitoring shows that erosion and damage to vegetation along access routes and on walking tracks is not increasing and that vegetation is recovering from past damage.
- Monitoring of breeding fauna species and vegetation in commercial educational Tourism Management Areas shows only minor or transitory impacts and disturbance resulting from educational tourism activities.

KDO 8: Air, land and waters of the reserve are relatively unpolluted by human activities.

Some key indicators are:

- Sewage and kitchen sullage waste is no longer disposed into the waters of the reserve.
- Incineration of waste is minimal due to more effective waste reduction and recycling methods.
- No fuel spills greater than 20 litres have occurred.

KDO 9: The historic heritage of the reserve is identified, recorded, protected and interpreted.

Some key indicators are:

- The 11 sites identified in the plan have been placed on the Tasmanian Historic Sites Register and are being maintained and managed according to conservation plans.
- Artefacts on station have been properly conserved, housed and are displayed.

KDO 10: The marine protected areas of the reserve and the Macquarie Island Marine Park are managed in a complementary and cooperative manner by the State and the Federal Governments and contribute to the outcomes of the National Representative System of Marine Protected Areas (NRSMPA).

Some key indicators are:

- The Service Level Agreement between the Tasmanian and Australian Governments for the cooperative management of marine parks is being adhered to.

- The areas are managed in accordance with ecologically sustainable use principles.

- Baseline studies of ecosystem function have been undertaken to provide a scientific reference for measuring impacts of activities in the region.

N.B. These key indicators are indicative only. They should be refined and further indicators should be developed along with monitoring programs to adequately inform management as to the success of their implementation of the policies and prescriptions of this management plan. These will be developed as soon as possible and publicised through the public awareness programs and consultation forums identified in Section 7 of this plan.