

MACQUARIE MARSHES NATURE RESERVE

PLAN OF MANAGEMENT

NSW National Parks and Wildlife Service.

May 1993

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FOREWORD

The Macquarie Marshes Nature Reserve protects part of the Macquarie Marshes wetland which is situated in the central part of northern NSW on the Macquarie River, approximately 100km north of Warren.

The Macquarie Marshes are one of the largest remaining inland semi-permanent wetlands in south-eastern Australia and are of international importance. The nature reserve samples all the habitat types present in the Marshes and is a major waterbird breeding area, an important refuge for a large number of other wildlife species and has significant cultural values.

This plan recognises that the nature reserve is, however, only a small part of the Macquarie Marshes and that ensuring adequate management, particularly with respect to water allocation, for the whole area of the wetland is an important wildlife management strategy.

Emphasis is placed in the plan of management on regional environmental planning programs and on public co-operation and liaison to achieve an adequate level of awareness and understanding within the local community of the water requirements and other management programs for the nature reserve.

Management of the nature reserve gives priority to maintaining Service staff on the reserve and on rehabilitation of the reserve to as natural a condition as is practicable. Water pollution, erosion and dieback will be controlled where possible; introduced plants and animals will also be controlled and, in conjunction with the Department of Water Resources, the water regime will be managed to maintain maximum diversity and productivity of wetland habitat. Significant Aboriginal sites will be protected and limited opportunities for public educational and recreational use of the reserve will be developed in the long term.

This plan establishes the scheme of operations for the Macquarie Marshes Nature Reserve. In accordance with the provisions of Section 75 of the National Parks and Wildlife Act, 1974, this plan of management is hereby adopted.

CHRIS HARTCHER

Minister for
the Environment

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1. INTRODUCTION

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

The procedures for the adoption of a plan of management for a nature reserve are specified in the Act:

- * Where a plan of management has been prepared, the Director is required to refer the plan to the National Parks and Wildlife Advisory Council for its consideration and advice.
- * The Director is then required to submit the plan to the Minister, together with any comments or suggestions of the Advisory Council.
- * The Minister may adopt the plan without alteration or with such alterations as he may think fit, or may refer it back to the Director and Council for further consideration.

Once a plan has been adopted by the Minister, no operations may be undertaken within the nature reserve except in accordance with the plan.

Although not a requirement under the Act, a plan of management for Macquarie Marshes Nature Reserve was placed on public exhibition for three months until January 1991, for comment on the proposals it contained.

All comments received were referred, along with the plan, to the National Parks and Wildlife Advisory Council for its consideration and advice. The comments and suggestions of the Advisory Council were, in turn, considered by the Minister when adopting this plan.

For simplicity, much background information has been omitted from the plan. For additional information or enquiries on any aspect of the plan, please contact the Service's Coonabarabran District Office at 56 Cassilis St, Coonabarabran or by phone on (068) 42 1311.

2. MANAGEMENT CONTEXT

2.1 NATURE RESERVES IN NSW

Nature reserves dedicated under the National Parks and Wildlife Act, 1974 are areas of special scientific interest containing wildlife or natural environments or natural phenomena.

The purposes of nature reserves are defined in the Act as:

- (a) the care, propagation, preservation and conservation of wildlife;
- (b) the care, preservation and conservation of natural environments and natural phenomena;
- (c) the study of wildlife, natural environments and natural phenomena; and
- (d) the promotion of the appreciation and enjoyment of wildlife, natural environments and natural phenomena.

Nature reserves differ from national parks which include as a major objective the provision of opportunities for outdoor recreation. The value of nature reserves lies in their role as refuge areas where natural processes, phenomena and wildlife can be studied, maintained and conserved.

2.2 MACQUARIE MARSHES NATURE RESERVE

2.2.1 Location, Description and History of Dedication

The Macquarie Marshes are located in the central part of northern NSW on the Macquarie River, approximately 100km north of Warren and 30km west of Quambone (see Locality Diagram on the Map). The Marshes comprise several discrete wetlands including two major areas, the South Marsh and the North Marsh. The Marshes include extensive areas of reed swamp, river red gum woodlands and water couch grasslands and are habitat for many species of waterbirds as well as other species of wildlife. The area of wetland varies from a remnant area during severe drought to more than 200 000 ha during major floods. The dry periods, however, are a critical part of the ecology of Australian wetlands management and are essential to the health of wetland ecosystems.

The nature reserve comprises three parcels of land totalling 18 143ha covering part of the South Marsh

and North Marsh. The Macquarie Marshes Nature Reserve was dedicated in January, 1971 and covers an area of Crown Land which was originally reserved in 1900 for the Preservation of Game. In 1919 the area became a Bird and Animal Sanctuary; in 1943 a reserve for the Preservation of Native Fauna and in 1955 a Fauna Protection District. The boundaries of the present nature reserve have changed only a small extent from the original reservation in 1900.

The Marshes are used principally for cattle grazing while sheep and cattle grazing and the cropping of irrigated and dry land occur in the surrounding countryside. The nature reserve was also grazed under licence until August 1990.

Regulation of the river by the Department of Water Resources for irrigation, flood mitigation and other purposes has altered the flow regime into the Marshes; both in terms of extent of inundation and seasonality.

2.2.2 Importance of the Macquarie Marshes.

The Macquarie Marshes Nature Reserve is the core of the Macquarie Marshes. It is the area most frequently flooded and contains samples of all the habitat types present in the Marshes. Nevertheless there are large and significant wetland areas outside the nature reserve, including extensive river red gum areas and some of the largest rookeries in the Marshes. These areas make a vital contribution to the value of the Marshes and include Duck Swamp at the northern end of the Northern Marsh, Gingham Swamp, Mole Marsh, Monkeygar Swamp north of Willie Road, Monkey Swamp, Buckinguy Swamp, the Terrigal/Gum Cowal Swamp and Marebone Forest, including the Jungle and Black Swamp.

The following statements of significance apply therefore to the whole Macquarie Marshes except where the nature reserve is specified.

Value as a Land System and Wetland Area

The Macquarie Marshes are a relatively little altered part of a major land system within NSW; the Northern Alluvial Fans (see section 4.1.1). The nature reserve is one of only two moderately sized conservation areas in NSW protecting a sample of this land system.

The Marshes are geomorphologically and geologically unusual as an active network of inland braided streams and deranged drainage patterns.

The Marshes are one of the largest remaining single inland semi-permanent wetlands in south-eastern Australia, and are still in a semi-natural state.

The Australian Heritage Commission has listed the Macquarie Marshes on the National Heritage Register and the National Trust has classified the Marshes as a Landscape Conservation Area in the National Trust Register.

The Macquarie Marshes Nature Reserve has been included on the List of Wetlands of International Importance (the Ramsar Convention).

Vegetation Value

The Macquarie Marshes are a prime example of the red gum - reed - water couch vegetation association. They contain the largest and the most northerly extensive area of reeds (*Phragmites australis*) in south-eastern Australia and a major area of river red gum (*Eucalyptus camaldulensis*) which is recognised as the largest occurrence in northern NSW. The Marshes have a variety of other vegetation types and include one of the most southern occurrences of coolibah (*E. microtheca*).

Value for Waterbirds

An important role of the Macquarie Marshes is as a breeding area for waterbirds. About 30 species of waterbirds breed in the Marshes and significant proportions of the total NSW population of a number of species breed there when conditions are suitable.

Egret rookeries in the Marshes are amongst the largest in NSW. The Marshes are a particularly important breeding area for the intermediate egret (*Ardea intermedia*). The area is one of the few in which the four species of inland egret; intermediate egret, little egret (*Ardea garzetta*), great egret (*Ardea alba*) and cattle egret (*Ardeola ibis*), breed together and one of the few areas where the three species of ibis breed together. The glossy ibis (*Plegadis falcinellus*) is only known to breed in nine other places in NSW. The magpi goose (*Anseranas semipalmata*) is now known to breed in the nature reserve.

Other waterbirds which breed in significant numbers in the Macquarie Marshes include cormorants, herons, spoonbills and eleven species of duck.

The Marshes are important for nine migratory birds which are specified in the Japan-Australia and China-Australia Migratory Bird Treaties including

the sharp-tailed sandpiper (*Calidris acuminata*), Japanese snipe (*Gallinago hardwickii*), black tailed godwit (*Limosa limosa*) and whiskered tern, (*Chlidonias hybridus*).

The Marshes are utilised by 18 endangered bird species including the freckled duck (*Stictonetta naevosa*), square-tailed kite (*Lophoictinia isura*), black falcon (*Falco subniger*), peregrine falcon (*Falco peregrinus*), and brolga (*Grus rubicundus*).

Value for other Native Animals

Extensive areas of the Macquarie Valley both above and below the Marshes have been cleared for grazing and cultivation. As a result the Marshes are a remnant of previously existing habitats and have become a regionally important refuge for wildlife.

Approximately 130 species of birds other than waterbirds, 15 species of fish, 4 species of turtles, 30 species of lizards, 14 species of snakes and 15 species of amphibians occur in the Marshes area. Mammals such as the red kangaroo (*Macropus rufus*), eastern grey kangaroo (*Macropus giganteus*), bats and the brush tail possum (*Trichosurus vulpecula*) are common. The Goulds long-eared bat (*Nyctophilus gouldii*), is at the western limit of its distribution. A number of small mammals have been recorded in the past but their numbers appear to have declined.

Cultural Value

The Macquarie Marshes were a favourable location for Aboriginal occupation and a range of significant sites have been recorded. Within the nature reserve, flooding is likely to have obscured sites but scarred trees are very common.

There are a number of Aboriginal oven mounds within the nature reserve. There are few such mounds in NSW and they have extremely high archaeological significance.

The Marshes are of historic interest as they were responsible for thwarting Oxley's 1818 expedition in search of an inland sea.

There are also a number of structures related to past agricultural use in the area which is now nature reserve.

Educational and Scientific Value

The variety of habitats and animals and the high significance of the area for waterbirds make the Marshes a valuable location for scientific research and teaching. They are used for educational visits by schools and universities.

Access is difficult and facilities are presently non-existent. There is however considerable potential for increased use for educational purposes and appropriate enjoyment of the values of the area by the public.

3. OBJECTIVES OF MANAGEMENT

3.1 GENERAL OBJECTIVES FOR NATURE RESERVES

The following general objectives relate to the management of nature reserves in New South Wales.

- * Protection and preservation of the scenic and natural features.
- * Maintenance of natural processes as far as possible.
- * Conservation of wildlife.
- * Preservation of Aboriginal sites and historic features.
- * Encouragement of scientific and educational enquiry into environmental features and processes and into Aboriginal heritage.

3.2 SPECIFIC OBJECTIVES FOR MACQUARIE MARSHES NATURE RESERVE

In addition to the above general objectives the management of the Macquarie Marshes Nature Reserve will be subject to the following specific objectives:

- * Maintenance of the reserve as a healthy and diverse wetland habitat for all native wildlife.
- * Maintenance of all types of native vegetation communities present within the reserve.
- * Maintenance of the reserve's value as a major waterbird breeding area.
- * Protection of the habitat of migratory birds which are the subject of international treaties for the protection of endangered species and their habitats.
- * Protection of significant Aboriginal resources within the reserve.
- * Improvement of knowledge related to management of the habitat values of the reserve.
- * Achievement of a water regime capable of maintaining the maximum possible extent, diversity and productivity of wetland habitat.

- * Protection of the reserve against erosion, sedimentation and pollution where these threaten its values.
- * Control of introduced plants and animals.
- * Assessment of opportunities for educational use and appropriate enjoyment of the reserve by the public.
- * Development of an awareness and appreciation of the value of the Macquarie Marshes, and of conservation generally, in the district community.
- * Encouragement of scientific research which is compatible with conservation objectives.
- * Encouragement of the appropriate use and management of the remainder of the Macquarie Marshes so as to protect wildlife habitat values and be compatible with management of the nature reserve.

3.3 OVERALL STRATEGY

The following strategy will be implemented in managing the nature reserve:

- * Initial priority will be given to consolidating a Service management presence in the reserve.
- * Management will be designed to encourage the return of the reserve to as natural a condition as is possible following cessation of grazing, and in a manner consistent with the above specific objectives of management.
- * Appropriate management of the water regime is recognised as being of fundamental importance and the Service will liaise closely with the Department of Water Resources to ensure that water management is as beneficial as possible.
- * High priority will be given to investigation of areas of degradation of the natural environment in the Marshes and monitoring and research needed to establish the most appropriate management policies and programs.
- * Public use of the reserve will not be encouraged until satisfactory management of the natural and cultural resources has been established. Investigation will be carried out, however, into

appropriate opportunities for educational and recreational use.

- * Close cooperation will be encouraged between the Service, appropriate authorities and landholders in the Marshes to exchange information and mutual management benefits.

4. POLICIES AND FRAMEWORK FOR MANAGEMENT

This section contains the policies and framework for the management of Macquarie Marshes Nature Reserve, together with relevant background information. Policies are summarised under three headings:

Natural Heritage;
Cultural Heritage; and
Use of the Nature Reserve

These policies will provide a framework for management consistent with the resources expected to be available to the Service and anticipated community trends for the next five to ten years. The actions identified within this plan are those to which priority will be given in the foreseeable future. Other management actions may be developed during the life of this plan in accordance with the policies set out in this plan.

4.1 NATURAL HERITAGE

4.1.1 Geomorphology, Hydrology, Soils and Water Quality

The Macquarie Marshes are located on early Tertiary alluvium in the Great Artesian Basin, within the Northern Alluvial Fans land system. This system comprises the lower reaches of the tributaries of the Darling River between the Barwon River and the Bogan River. Since the end of the Pliocene (2-5 million years ago) these streams have created a number of large outwash fans from waste material eroded out of the eastern highlands. These have coalesced to form a large system of permanent and ephemeral interconnected or braided channels. Most of the alluvium was deposited by prior streams during a wetter period. These streams are clearly defined along the western margin of the Marshes and occur sporadically to the east. There has been only limited deposition by the present stream system. It appears that swamps have existed in the area for a long time and have been restricted in recent periods to their present locations as a result of the currently much drier climatic conditions.

The landscape of the Marshes is nearly level. There are four main landforms:

- braided swamps which consist of a maze of shallow channels and low swampy interfluves;
- lagoons, mostly ephemeral, which are overflow depressions, back swamps and terminal sumps of present and prior streams;

- channel country which appears similar to braided swamps but occurs on higher, only occasionally flooded ground and has deeper channels; and
- gilgaied floodplains which consist of hollows and rises up to 10m wide and 70cm relief. These are best developed on land that is only occasionally flooded.

The braided swamps and associated lagoons form the most important permanent and semi-permanent wetland habitats.

The wetlands of the Marshes depend on inundation from flooding of the Macquarie River and its effluents. The main streams of the nature reserve are the Macquarie River, Monkeygar creek, and the Bora Channel. These have numerous offshoots and breakaways and the resulting pattern of channel country and braided swamps is most marked in the North Marsh. The South Marsh has a main central carrier stream (Monkeygar Creek). It needs a greater flow rate than the North Marsh to cause inundation of the wetlands and is more open.

There has been recent stream bed and bank erosion with sediment deposition at numerous locations in the Marshes. Most of these impacts are probably part of long term changes in drainage patterns and demonstrate the inherent instability of the Marshes but some may be caused by human interference. A major concern is recent erosion and deepening of the channel of Monkeygar Creek, resulting in a decreased area of flooding in the Southern Marsh and severe vegetation degradation.

Surplus river flows are carried across the northern Marsh by the Northern Marsh Channel, constructed on the eastern side of the reserve. Significant hydrologic, waterlogging, erosion, sedimentation, salinity and dieback problems appear to be associated with the channel and are affecting important habitat areas. Investigation is needed of the works necessary to prevent or at least minimise these impacts. Survey of reptile and amphibian populations is needed, particularly of amphibians, which may act as indicators of water quality in the Marshes.

Irrigation upstream may be resulting in salinity and pesticide pollution of the water entering the Marshes and changes in ground water levels and quality. This would adversely effect the health of the wetlands and the success of waterbird breeding, grazing values in areas outside the nature reserve and downstream water users. Of particular concern

is the high use of pesticides in the cotton growing areas. A program of water quality testing and investigation of ground water levels has been commenced by the Department of Water Resources.

Tree dieback and clearing within the Marshes system and upstream may also affect water quality by removing the filtering role of natural vegetation and raising groundwater levels. The Marebone Forest area is located at the "entrance" to the Marshes and is considered to be crucial to the wellbeing of the entire system. The forest, however, is seriously threatened by clearing and development for irrigation.

Promotion of the principles of Total Catchment Management in cooperation with the Central West Catchment Management Committee would encourage protective management of areas of the Marshes outside the reserve and upstream and help mitigate adverse impacts of agriculture and grazing use.

Policies

- * Erosion and sedimentation are recognised as naturally occurring processes in the Marshes. Where these processes have been accelerated by human works or are threatening significant habitats or other values of the nature reserve, appropriate control measures may be undertaken.
- * Where significant water pollution or changes in groundwater levels are shown to be affecting wetland values the Service will seek their urgent correction in conjunction with appropriate authorities and water users.
- * The principles of Total Catchment Management are supported by the National Parks and Wildlife Service and will be promoted in co-operation with Total Catchment Management and Landcare organisations.

Actions

- * Investigation will be undertaken in conjunction with the Department of Water Resources into the cause and degree of changes in the Southern Marsh and, if desirable and feasible, measures will be undertaken to reverse this decline.
- * Hydrologic, waterlogging, erosion, sedimentation, salinisation and dieback problems associated with the Northern Bypass channel will be investigated in conjunction with the Department of Water Resources. The Department

will be asked to undertake such works as are necessary to correct these problems.

- * The Service will seek the protection of the Marebone Forest area from clearing and in conjunction with relevant land use authorities and local landholders, seek protection of other areas of natural vegetation likely to make a significant contribution to the maintenance of water quality and water levels in the Marshes system.

4.1.2 Water Management

The Macquarie River is regulated for irrigation and other water supply requirements, with headwater storage in Burrendong Dam. The dam has been storing water since 1965. A Water Management Plan developed jointly by the Service and the Department of Water Resources controls water allocations in the Marshes. It aims to manage water resources so as to ensure maintenance of the wetland habitat and suitable conditions for waterbird breeding while meeting the requirements of other water users. Implementation of the provisions of the Water Management Plan is vital to maintenance of the wetland habitats in the Marshes. The Plan sets a water allocation of 50 000 megalitres per year for the Marshes from regulated flow and provides for the Marshes to receive the majority of baseline flows, with a number of rules governing water release.

Maintenance of the extent, productivity and diversity of the wetland habitat of the Marshes depends largely on them receiving a water regime as similar as possible to that existing prior to regulation of the river system, to which the biota had adapted. Large fluctuations in inundation are a normal part of the Marshes system.

The operation of Burrendong Dam and the growth in irrigation has considerably reduced the amount of water reaching the Marshes and altered the frequency of various flow rates, with consequent detrimental effects on the ecology of the Marshes. The occurrence of minor floods (freshes) and medium sized floods has decreased, particularly between the months of July and October, while moderate flow has increased and the Marshes no longer dry out completely.

The wildlife allocation is insufficient in itself to stimulate or maintain waterbird breeding and surplus flows are the predominant water supply to the Marshes in most years. It is essential that the Marshes continue to receive the highest priority for large surplus flows. Current understanding of the

ecology of wetlands suggests that numbers of breeding waterbirds increase exponentially in relation to increased water levels after a certain threshold is reached. Frequent small surplus flows may be detrimental, however, as they may prevent drying out between floods.

Present understanding by Service specialists indicates that flooding between late winter and early summer is the most productive waterbird ecology but autumn floods are also beneficial. Continuous inundation for at least four to six months is necessary for plant and invertebrate succession and for successful waterbird breeding. Floods of shorter duration result in massive mortality and failure of the breeding colonies. On the other hand, flooding for longer than two years can cause vegetation death and loss of invertebrate productivity.

Periodic drying out is essential for the health of many of the vegetation types in the Marshes and for aerobic decomposition of soil nutrients. Re-flooding then results in large increases in invertebrate populations and hence in the food resource for waterbirds and fish. Regular small flows are preventing drying out of the reserve and investigation is needed into ways to overcome this. Present information indicates that areas should remain dry for at least three months but no longer than about two years.

As yet there is insufficient understanding of all components of the Marshes system and their interaction. It is not known for example whether it is a certain depth or rate of build up of water which is necessary to stimulate waterbird breeding. The Water Management Plan provides for monitoring of the effect of various water regimes on flooding and wetland productivity and of erosion and sedimentation. Further specific research is also needed (see also sub-sections 4.1.3 and 4.1.4).

The nature reserve consists of two widely separated areas and is an integral part of the whole Marshes system. Maintenance of wetland habitat and a beneficial water regime outside the reserve is essential for protection of the high ecological values of the Marshes, their continued biological productivity and the health of the whole system including protection of water quality and grazing interests. It is therefore not generally desirable to attempt to manage water flow within the nature reserve separately from the rest of the Marshes. To do so would require extensive control works with associated detrimental impact on the environment of

the Marshes. Works to dry out parts of the reserve which are continually wet by baseline flows may be feasible, however, and may have considerable ecological benefit.

Policies

- * The Water Management Plan is vital to maintenance of the habitat values of the Marshes and health of the Marshes system. The provisions of the Water Management Plan will be implemented in cooperation with the Department of Water Resources.
- * It is recognised that the water regime of the Macquarie Marshes is permanently altered and reduced by regulation of flow for domestic, stock and irrigation purposes. As far as is possible within external constraints and the extent of current knowledge, the water regime will be managed to maintain maximum diversity and productivity of wetland habitat in the nature reserve and in particular to provide conditions suitable for waterbird breeding.
- * Water management will include provision of a sufficient amount and depth of flooding, optimum timing of flooding and periods of drying out.

Actions

- * The Service in conjunction with the Department of Water Resources will continue experimentation and research to determine the most efficient and beneficial use of the wildlife allocation and surplus flows.
- * In conjunction with the Department of Water Resources the possibility of manipulating water flow to periodically dry out areas of the Marshes which are currently continually wet by baseline flows will be investigated. Possible impacts on subsequent flooding and downstream water users will be taken into consideration.
- * Close liaison will be maintained with the Department of Water Resources and where appropriate other authorities and landholders on all water management issues.

4.1.3 Native Plants

The vegetation of the Macquarie Marshes is diverse and patterns shift in response to changes in water levels. Minor differences in elevation caused by

channel relief and gilgai formations are associated with marked localised vegetation differences.

There are three major vegetation associations in the nature reserve: river red gum, reed swamp and water couch grasslands.

River red gum (*Eucalyptus camaldulensis*), occurs mainly along the watercourses in the South Marsh and in large stands in the channel country in the North Marsh. It is commonly associated with river cooba (*Acacia stenophylla*). Cumbungi (*Typha domingensis*) and common reed (*Phragmites australis*) occur along the channels and water couch (*Paspalum paspalodes*) is the dominant groundcover.

River red gum requires seasonal flooding and needs flooding to regenerate but prolonged waterlogging causes severe die-back and death. There are extensive areas of dead river red gums in the Marshes, some of which have been ringbarked but most have died as a result of prolonged flooding in the 1950's and at other times. Some areas of river red gum in the nature reserve exhibit dieback. Altered river flows, prolonged flooding, salinity, water table changes and insect attack are possible causes.

Lack of river red gum regeneration is a concern in parts of the Marshes. Investigation of causes and possible corrective action are needed.

Common reed forms large dense stands, mainly in braided swamp country, in both the North and South Marsh in the nature reserve. The area of reed in the South Marsh has greatly decreased since the 1930s, however, because of the capturing of most of the Macquarie River's flow by Monkeygar Creek. Grazing may also be causing a decline in the extent of these reed beds.

Water couch is the dominant ground cover in many areas of the nature reserve and is present in all land types. It has a wide range of water tolerance and responds very rapidly to flooding. Other grasses and herbs may also be present.

Other vegetation types are smaller in extent within the nature reserve. They consist of the following:

Box Woodland occurs on ground that is only occasionally flooded but needs flooding to regenerate. It consists of scattered coolibah (*Eucalyptus microtheca*) or black box (*E. largiflorens*).

Lignum (*Muehlenbeckia cunninghamii*) grows mainly in channels in pure stands or associated with river red gum. Large areas of this community outside the reserve have been cleared.

Cumbungi grows in areas of relatively permanent water in braided swamp country in the North Marsh of the reserve. It does not survive prolonged dry periods but readily re-establishes once flooding recurs.

Mixed marsh vegetation occurs in braided swamps and varies in extent according to water levels. It includes low aquatic vegetation, emergent reed, cumbungi, water couch, semi-aquatic herbs and sedges.

Mixed grassland is characteristic of the gilaied floodplain with spike rush (*Eleocharis plana*) and rush (*Juncus aridicola*) predominating in the hollows and a variety of grasses occurring on the flats and rises. It dies off in dry times.

Lagoons which are relatively deep have mainly cumbungi and reed interspersed with open water. Shallow lagoons have little vegetation when wet and are pioneered by semi-aquatics, dryland weeds, chenopods and eucalypts as they dry out. These plants seldom survive either drying out or reflooding.

Chenopod shrubs and grasses are the dominant vegetation on the higher ground adjacent to the marshes. They are rarely flooded.

The different land forms, vegetation types and changing water levels in the Marshes combine to form a complex of wetland and dryland environments which are of very high value to wildlife. Most of the vegetation types described above are utilized in different ways by waterbirds. Those which are particularly important are the river red gum woodland, lignum, reed, cumbungi, water couch and the lagoons. Water couch meadow is the prime feeding habitat for many species while the other important vegetation types primarily provide shelter and roosting and nesting sites. Some species are largely confined to particular vegetation types. For example the little grass bird (*Megalurus gramineus*), brown bittern (*Botaurus poiciloptilus*), little bittern (*Ixobrychus minutus*) and some crakes are confined to common reed. The clamorous reed warbler (*Acrocephalus stentoreus*) favours a mixed reed and cumbungi plant community. Damage to the reed beds such as by control burning therefore temporarily destroys a large part of their habitat.

While all the vegetation types of the Marshes are represented in the nature reserve there is little box woodland or lignum. Large areas of lignum have been cleared outside the nature reserve. Half of the important river red gum association lies outside the nature reserve adjacent to the northern boundary. The nature reserve contains few rarely flooded areas yet these are important in providing habitat and flood refuge for non aquatic animals.

Policies

- * The complete range of vegetation types occurring in the Macquarie Marshes will be protected within the nature reserve.
- * The Service will seek to protect significant habitat areas outside the nature reserve. As far as possible this will be achieved with the co-operation of landholders and by such means as voluntary conservation agreements.

Action

- * Areas of river red gum dieback and regeneration will be mapped. Causes of dieback and lack of regeneration will be investigated. Measures will be taken where appropriate and practicable to halt dieback and encourage regeneration.

4.1.4 Native Animals

Changes in the water regime, vegetation clearing and damage, competition and predation from introduced animals are likely to have reduced populations and species diversity of native animals in the Macquarie Marshes. Nevertheless the Marshes are a very important habitat and support a large variety of wildlife.

Some 191 species of birds have been recorded in the nature reserve and surrounding areas of which almost one third are waterbirds.

The breeding of swans, magpie geese, brolga, ibis, herons, egrets, spoonbills, grebes, cormorants, pelicans and ducks is stimulated by flooding. Some breed as the water level rises and others after the maximum level has passed. Ibis nest on reed, lignum, river red gum and cumbungi over water. Most other species nest in live river red gums although a number also nest in lignum.

A large variety of land birds inhabit the Marshes including emus, parrots, robins, wrens and birds of prey.

Red kangaroos (*Macropus rufa*) and the eastern grey kangaroo (*Macropus giganteus*) occur adjacent to the wetlands and bats and the brush-tailed possum are numerous throughout the district. Small mammals such as the yellow-footed antechinus (*Antechinus flavipes*), the ringtailed possum (*Pseudocheirus peregrinus*), the water rat (*Hydromys chrysogaster*) and echidna (*Tachyglossus aculeatus*) have been recorded fairly recently but a number of other species of small mammals appear to have disappeared from the Marshes. Predation by cats and foxes, loss of cover caused by stock grazing and compaction of the grey cracking soil by cattle trampling appear largely responsible for the decline in species and numbers.

The Marshes provide habitat for a wide range of reptiles and amphibians but it is probable that grazing, predation and burning have reduced the number of these important native animals. There is little information on the distribution, numbers and habitat requirements of reptiles and amphibians.

Native fish which occur in the Marshes include golden perch (*Macquaria ambigua*), bony bream (*Nematalosa erebi*) and catfish (*Tandanus tandanus*). The introduced carp (*Cyprinus carpio*) is predominant, however, in both the flowing and still waters of the Marshes. Fish spawning is dependent on spring and summer floods and inundation of dry land is important for plankton production. The numbers and diversity of native fish in the Marshes have greatly declined in recent years and an investigation is needed into the causes of this decline. The authority responsible for the management of fish is NSW Fisheries.

Invertebrates are important food sources for waterbirds and fish. Populations are stimulated by flooding of dry land. NSW Fisheries policies such as "Freshwater Habitat Management Guidelines" and "Draft Conservation Strategy for Inland Rivers and Streams" provide valuable guidelines for management of the Marshes and opportunities for co-operation between the NSW Fisheries and the Service in the promotion of environmentally responsible aquatic habitat management.

Policies

- * As far as is practicable populations of all species of native animals within the nature reserve will be maintained.

- * No development or public access will be permitted near waterbird rookeries except for approved research purposes.

Actions

- * Waterbird breeding events will be monitored.
- * Surveys will be carried out to determine the presence and abundance of native animal species in the nature reserve in various habitats. Priority will be given to the survey of small mammals and amphibians.
- * Research will be encouraged into the ecology of the major waterbirds which breed in the nature reserve, and in particular an investigation of the factors important for breeding success within the Macquarie Marshes will be carried out.
- * Selected waterbird species will be monitored to determine variation in distribution, abundance and habitat usage (for feeding, resting and nesting) with changes in water levels.
- * The Service will liaise with NSW Fisheries and the Department of Water Resources to determine the fish and invertebrate populations in the Marshes and their relationships to water regime and water quality. Opportunities for the co-operative promotion of environmentally responsible management will be explored.
- * The Department of Water Resources will be kept informed of the results of monitoring and research work, particularly in relation to waterbird breeding events and their responses to floods and water releases.

4.1.5 Introduced Plants and Animals

Weed species present in the nature reserve include noogoora burr (*Xanthium occidentale*), Bathurst burr (*X. spinosum*) and a number of species of thistle. Control of these species requires regular effort because floods disperse fresh seed. Lippia (*Phyla nodiflora*), occurs along the length of the Northern Bypass Channel and penetrates up to 100m into river red gum woodland on the western side of the channel.

Weed control measures used are manual removal and, where appropriate, spraying with herbicides. Spraying is avoided in wet areas and during bird breeding times. Biological control of noogoora burr

has been introduced by the Castlereagh Macquarie Weeds County Council.

Introduced animals in the nature reserve include cattle, sheep, feral pigs, foxes, rabbits, feral cats, black rats and house mice. Cattle, sheep and pigs may have caused significant reduction in numbers of waterbirds and other native animals through food competition, habitat destruction, disturbance of nesting birds and inhibition of regeneration of river red gum. Pigs also eat eggs and young animals.

The Marshes provide abundant habitat suitable for feral pigs and regular helicopter shooting is carried out in co-operation with Rural Lands Protection Boards, the Feral Pig Committee and neighbouring landholders.

Sheep and cattle grazing was undertaken under licence in the nature reserve until August 1990 when the then expiring licences were not renewed. The Australian biota has not evolved in the presence of large grazing animals and commercial grazing prevents management of the nature reserve for the greatest benefit to native plants and animals. Straying sheep and cattle will be required to be removed from the nature reserve.

Predation by foxes and feral cats has probably affected numbers of birds and small animals and contributed to the absence of many of the small mammal species which were originally present in the Marshes.

Policies

- * Introduced plants and animals will be controlled where they threaten native plant and animal communities or have been declared noxious. Preference will be given to control techniques which have minimal environmental impact and, in particular, do not affect waterbird breeding.
- * Control programs will be planned in consultation with neighbours and appropriate authorities and will wherever practicable undertaken as part of a co-operative program.

Actions

- * A weed management program will be prepared in consultation with the Castlereagh Macquarie Weeds County Council detailing control methods, monitoring and priority areas.

- * Control of feral pigs will continue.
- * A control program will be developed for foxes and feral cats.
- * A monitoring program will be carried out to record changes occurring in vegetation and other factors after grazing ceases.

4.1.6 Fire Management

Fire is a natural feature of the Australian environment and is essential to the survival of some plant communities. Fire can cause significant damage to wetland communities, however, particularly when they are dry.

There is little information on the environmental effect of frequent burning in the Marshes. It appears, however, to have changed the structure and pattern of the vegetation and favoured annual species over perennial species. Fire may have contributed to the death and lack of regeneration of river red gum. Fire also reduces plant cover for native animals.

Fire in dry periods may result in lower soil levels and reduce the water holding capacity of the wetlands by destruction by burning of organic matter. Research is therefore needed to develop a fire management program based on the requirements of the nature reserve's natural systems and wildlife.

Use of earthmoving equipment for fire fighting could cause considerable damage to the wetland soils and is avoided except in emergencies.

The Service is required under the Bush Fires Act, 1979 to take all practicable steps to prevent the occurrence of fires on, and to minimise the danger of spread of fires on or from the nature reserve. Fire control is carried out in co-operation with local Volunteer Bush Fire Brigades.

Policies

- * Fire will be managed in the Macquarie Marshes to ensure:
 - the protection of human life and property;
 - protection of significant habitats, plant communities and rare species;
 - protection of waterbird breeding sites;

- the maintenance of those plant communities and plant or animal species which are adapted to a particular fire frequency or intensity;
 - protection of Aboriginal sites and historic places; and
 - protection of management and visitor facilities.
- * As far as possible fire will be excluded from sensitive areas such as river red gum stands, waterbird rookeries, Aboriginal and historic sites.
 - * Hazard reduction will be undertaken where warranted to protect neighbouring properties, significant habitats, fire sensitive vegetation, cultural resources, management facilities and visitor facilities.
 - * As far as possible control burning of wetland communities will be carried out only when there is adequate soil moisture to prevent burning of soil organic matter.
 - * Earthmoving equipment will not be used in areas identified as environmentally sensitive except in cases of emergency.
 - * Close liaison will be maintained with local bushfire brigades, other appropriate authorities and neighbours in order to attain co-operative fire management.

Actions

- * A fire management plan will be prepared by June 1994 and reviewed annually, detailing fire management programs and strategies, co-operative arrangements and resource and neighbouring lands protection considerations.
- * Records will be maintained of the frequency, pattern and impact of fires.
- * Research will be undertaken into the ecological relationships of fire in the nature reserve and used to develop an appropriate fire management program.
- * Areas which would be damaged by use of earthmoving equipment during fire suppression will be identified and mapped.

4.2 CULTURAL HERITAGE

4.2.1 Aboriginal Sites

The Macquarie Marshes are a productive wet area in a semi-arid plain. They would have been a significant feature and an important source of water and food for Aboriginal people. The Marshes were probably the home of the Wayilwan people. Aborigines with traditional ties with this area live in various towns in the district.

Traditional Aboriginal culture would have been strongly influenced by the Marshes environment and changing water regimes and may have differed from the surrounding cultures of the dry western plains environment.

It is unlikely that many Aboriginal sites will be found in the Macquarie Marshes because of changing channel patterns, continuing deposition and the dispersal of archaeological deposits by floodwaters. Nevertheless the importance of the area is shown by those few sites which have been found in or adjacent to the wetlands. These include surface campsites, scarred trees, earth mounds, ceremonial grounds and burial grounds.

A systematic sample survey of Aboriginal sites in the nature reserve found over 100 sites, including 70 earth mounds, 25 scarred trees, 5 campsites and scattered isolated artefacts.

The Aboriginal earth mounds have extremely high archaeological significance at a local, regional and national level as they are the only examples of this type of mound which have been located outside the Murray Valley. Little is currently known about the construction, function and role of the mounds in the Aboriginal economy and their presence in the Macquarie Marshes poses interesting questions about the cultural relationships between the Aborigines of the Murray Valley and of the Darling River corridor.

Policies

- * All works proposed for the nature reserve will be preceded by an Aboriginal sites survey.
- * Knowledge of Aboriginal use of the area will be improved through both archaeological and anthropological research, and such information

will be used, where appropriate, to promote public understanding and appreciation of Aboriginal culture.

- * Because of the rarity and significance of Aboriginal sites in the nature reserve the exact location of sites will not be publicised except where a conservation plan has been prepared and specific management works designed to protect the site from damage have been implemented.
- * Any Aboriginal site publicised for visitor access will be interpreted so as to promote public understanding and appreciation of Aboriginal culture, and to assist in the sites' protection.
- * The Local and Regional Aboriginal Land Councils will be consulted in the management of Aboriginal sites.

Actions

- * A systematic survey and recording of Aboriginal sites will be undertaken in the nature reserve.
- * Management works will be undertaken where appropriate for sites found to be endangered by erosion and human interference.
- * Conservation plans will be prepared for sites of particular significance including the earth mounds.
- * A research program will be developed to record knowledge held by Aboriginal people in the district.

4.2.2 Historic Places

The Macquarie Marshes were first discovered during Oxley's 1818 expedition in search of an Australian inland sea. They were also explored by Sturt and Hume in 1828 and the first survey was carried out by Surveyor White in 1847.

Settlement of the Marshes began in the 1840's and the area was used almost exclusively for cattle and sheep grazing.

The first settler was George James Gibson who grazed cattle on the Macquarie River. He and Henry Wadge were buried on the banks of the river (not in the nature reserve) and their graves were marked as an "historic site" by Warren Shire Council in 1979.

Structures within the nature reserve include yards, fence lines, sheds, tanks, water diversion and water control structures. Some may be of historical significance and survey and assessment are needed to determine this significance.

Policies

- * The provisions of the Australia ICOMOS Charter for the Conservation of Places of Cultural Significance (the Burra Charter) will guide management decisions for the historic places found on the Macquarie Marshes Nature Reserve.
- * Conservation plans will be prepared for culturally significant places.
- * Historic places will be protected from disturbance until their significance has been assessed.
- * Selected historic places may be interpreted to the public.

Actions

- * The nature reserve will be progressively surveyed for historic places and the significance of such places will be assessed.
- * Historic places will be recorded on the Service's Historic Places Register.

4.3 USE OF THE NATURE RESERVE

Macquarie Marshes Nature Reserve will be managed to ensure that its use, whether by the general public, special interest groups, Service managers or other authorities, is appropriate and conforms with the Act and the management objectives and policies of this plan.

The major categories of use which may be appropriate within Service areas are:

- * promotion of natural and cultural heritage conservation;
- * environmental education;
- * scientific research;
- * recreation in a natural setting; and
- * management operations by the Service and other authorities.

The extent to which these categories of use are appropriate to Macquarie Marshes Nature Reserve are indicated below.

4.3.1 Public Access and Use

The Macquarie Marshes Nature Reserve, because of its natural heritage significance, variety and size has the potential to be an important environmental educational resource. However, public use is currently limited because of restricted road access, the absence of facilities, the isolation of the nature reserve and the changing and difficult nature of the terrain. Roads on the grey cracking soils become impassible when wet. River flow is also often unsuitable for boat access and the extensive areas of braided channels and tall stands of reed restrict navigation on the waterways.

During waterbird breeding events human presence at rookeries must be kept to a minimum as adult birds commonly leave their nests on the slightest disturbance.

Because of the above difficulties and because of staff and financial limitations and the need to consolidate Service management operations in the nature reserve, provision for public access to the nature reserve will be given low priority. Proposals for public use of the nature reserve will be thoroughly assessed prior to provision of any facilities.

Policies

- * Appropriate public use of the nature reserve may be permitted where it will not interfere with waterbird breeding, disturb significant habitats or cause damage to the environment.
- * Public use will not be encouraged until satisfactory management of the natural and cultural resources has been established.
- * Understanding and appreciation of the natural and cultural values of the nature reserve by the public will be encouraged.
- * Priority will be given to providing information and facilities which assist management to protect the natural and cultural resources of the nature reserve.

- * Low key visitor facilities may be developed where appropriate and feasible, consistent with the above policies.

Action

- * Proposals for public educational and recreational use of the nature reserve will be thoroughly assessed prior to provision of any facilities.

4.3.2 Research

There is scope for a wide range of research projects in the Macquarie Marshes. Appropriate research will lead to improved management of the nature reserve and enhanced educational value.

A number of specific research areas to be undertaken by the Service are discussed in earlier parts of this plan. The Water Management Plan also lists some areas of research to be carried out by or in conjunction with the Department of Water Resources.

Policies

- * Research will be permitted and encouraged into all aspects of the ecology of the Macquarie Marshes where it is demonstrated that the research will not have a significant environmental impact and in particular will not interfere with waterbird breeding.
- * Priority will be given to research which will directly assist management of the nature reserve.

4.3.3 Management Use

As resources permit, management facilities will be progressively established. Day to day management operations on the nature reserve will be undertaken by an officer based at the nature reserve.

Considerable local knowledge and experience is held by the adjacent landholders and close cooperation between the Service and the local community is essential for exchange of information and mutually beneficial management. Community groups such as the Macquarie Marshes Catchment Management Sub-committee and the Macquarie Flood Plains Landcare Association provide opportunities for liaison with the community, as well as direct co-operation with landholders.

A local environmental plan being prepared by Warren and Coonamble Shire Councils and a regional environmental plan proposed by the Department of Planning may affect land use and development in the Marshes and possibly the nature reserve. The Service will liaise with these authorities to seek provisions which protect the important natural values of the Marshes.

All reserve boundaries will be fenced in cooperation with adjacent landholders. Internal fencing will not be maintained and will be progressively removed.

Policies

- * The Service will liaise with Warren and Coonamble Shire Councils and the Department of Planning regarding planning instruments prepared for the Marshes.
- * The Service will also liaise closely with landholders and relevant community groups to encourage the exchange of information and co-operative management.
- * Facilities will be established to enable satisfactory management of the reserve.
- * Facilities such as toilets and rubbish disposal will be located and designed to avoid pollution of wetlands.
- * Access for management purposes will avoid use of vehicles where they may damage habitats.

Actions

- * The Service may, in accordance with its policy on fencing assistance, assist neighbouring landholders to erect stock proof fences on the boundary of the reserve.
- * The wire of internal fencing will be removed except where it serves an essential management purpose. Fence posts other than corner posts and strainers will be removed where they cross waterways or otherwise interfere with the optimum maintenance of natural processes in the reserve.
- * Structures, other than those of historic interest, which do not serve a management function will be removed.

5. PLAN IMPLEMENTATION

This plan of management is part of a system of management developed by the Service. The system includes the National Parks and Wildlife Act, management policies, established conservation and recreation philosophies and strategic planning at corporate, regional and district levels.

The orderly implementation of this plan of management will be undertaken within the annual programs of the Service's Coonabarabran District. Priorities, determined in the context of district and regional strategic planning, will be subject to the availability of necessary staff and funds and to any special requirements of the Minister or Director.

District programs are subject to ongoing review, within which, works and other activities carried out in the Macquarie Marshes Nature Reserve are evaluated in relation to the objectives laid out in this plan.

The environmental impact of all development proposals will continue to be assessed at all stages from planning to implementation, and any necessary investigations will be undertaken in accordance with established environmental assessment procedures.

Under Section 81 of the National Parks and Wildlife Act, 1974, this plan shall be carried out and given effect to and no operations will be undertaken within the Macquarie Marshes Nature Reserve except in accordance with the plan. However, if after adequate investigation, operations not included in the plan are found to be justified, this plan will be amended in accordance with Section 76 (6) of the Act.

As a guide to the orderly implementation of this plan of management, relative priorities for identified activities are summarised below:

Activity	Plan Reference
High Priority	
Monitor waterbird breeding events	4.1.4
Investigate river red gum dieback and regeneration	4.1.3
Erect boundary fencing	4.3.3

Protect endangered Aboriginal sites	4.2.1
Control feral pigs	4.1.5
Prepare fire management plan	4.1.6
Establish essential management facilities	4.3.3
Investigate impacts of Northern Bypass Channel and ask Department of Water Resources to carry out correction works.	4.1.1
Assess changes taking place in South Marsh	4.1.1

Medium Priority

Keep Department of Water Resources informed re monitoring and research	4.1.4
Prepare Aboriginal site conservation plans	4.2.1
Control foxes and feral cats	4.1.5
Prepare weed management program	4.1.5
Research fire ecology	4.1.6
Identify areas which would be damaged by use of earthmoving equipment during fire suppression	4.1.6
Monitor waterbird distribution	4.1.4
Survey native animals	4.1.4
Survey Aboriginal sites	4.2.1
Survey historic sites	4.2.2
Encourage anthropological research	4.2.1

Low Priority

Encourage research into fish and invertebrates	4.1.4
Maintain fire records	4.1.6
Research waterbird ecology	4.1.4
Remove internal fencing	4.3.3
Investigate measures to dry out parts of reserve	4.1.2

Investigate opportunities for public use 4.3.1

Remove unwanted structures 4.3.3

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