# TUCKEAN NATURE RESERVE

# PLAN OF MANAGEMENT

**NSW National Parks and Wildlife Service**

**April 2002**

**This plan of management was adopted by the Minister for the Environment on 24th April 2002.**

**Acknowledgments:** The principal author of this plan was Christine Wolf, a German University student on study in Australia, with assistance from Northern Rivers Region staff and the Northern Directorate and Head Office planning staff.

Cover photograph: Tuckean Nature Reserve upstream of the Bagotville Barrage, by Christine Wolf.



**ISBN: 0 7313 6340 X**

# FOREWORD

Tuckean Nature Reserve covers an area of approximately 916 hectares on the Tuckean Swamp near Broadwater in far northern New South Wales. The Reserve is a remnant of the original swamp that has now been largely cleared and drained for agriculture. Runoff from the Tuckean Swamp feeds into the Richmond River and is occasionally a source of poor quality water.

The Reserve forms part of a regional network of protected wetlands, including nearby Ballina Nature Reserve. The management of the hydrology is one of the most critical issues in ensuring the protection of the Reserve's natural values, water quality and protection from flooding of farmlands within the catchment of the Reserve.

The plan of management recognises the conservation values of the Reserve and the needs of lands and waterways both upstream and downstream of the Reserve. Visitor facilities, including public vehicular access, will not be provided in order to minimise impacts on the Reserve, however, nature based activities not requiring facilities, such as bird watching and canoeing, will be permitted.

The draft plan of management was placed on public exhibition for approximately two months from June to August 2001. The draft plan has been amended to reflect comments received from the public submissions on the draft plan of management, the NPWS Northern Rivers Regional Advisory Committee and the NSW National Parks and Wildlife Advisory Council.

This plan of management establishes the scheme of operations for Tuckean Nature Reserve. In accordance with the provisions of Section 76 of the *National Parks and Wildlife Act 1974*, this plan is hereby adopted.

**BOB DEBUS**

**Minister for the Environment**

# MANAGEMENT CONTEXT

## Location and Regional Setting

Tuckean Nature Reserve (referred to as the Reserve in this plan) is situated approximately 25km southwest of Ballina and 15km north of Woodburn in northern NSW (see map 1). It forms the connection between Tuckean swamp and the Tuckean Broadwater, a tidal reach of Richmond River.

The Reserve was dedicated on 1 September 1982, covering an area of 550 hectares. An additional 366 hectares of former Crown Land was added on 5 March 1999, taking the total area of the Reserve to 916 hectares. Drains and roads within the Reserve are included, except for Hendersons drain which traverses Lot 125 north of the confluence with Stony Island drain (see map 2). To the northwest are two lots, comprising 76 hectares, which are separated from the core area. The major part of the Reserve lies within a designated wetland (no.114), pursuant to “State Environmental Planning Policy No. 14 – Coastal Wetlands”.

The Reserve forms part of Tuckean Swamp, a coastal floodplain of the Richmond River. The area has been changed significantly through drainage management over more than 100 years. The establishment of drains to reduce flood peaks and flood duration has led to a lowering of the water table with resultant acid sulfate soil issues and the relative drying of sections of former wetland in the Reserve.

Surrounding land uses are predominantly cattle grazing, sugar cane and soy bean production. To prevent salt-water intrusion on the farmlands, a tidal barrage, known as the Bagotville barrage, commenced operating in 1971. The Richmond River County Council manages the barrage, which is located on the lower reaches of the drainage system adjoining the Reserve.


**Map: The Tuckean Nature Reserve, showing major drains and streams and regional setting**

# NATURAL AND CULTURAL HERITAGE VALUES – A SUMMARY

## Geology, landform and hydrology

The Reserve is part of the Tuckean Swamp, occurring in a sub-catchment of the Richmond River. It is a naturally infilled lagoon located on a basin in old metamorphic rock covered by marine sands and overlain by sedimentary deposits of Quaternary estuarine clays and alluvium sands. In the estuarine clays, conditions for pyrite formation have created the potential for acid sulfate soil development. Dominant soil materials in the Reserve are moist sandy loams or peaty clay loam on clay forming poorly drained and waterlogged humic gleys (Morand1994). The water table is less than one metre below the ground surface.

The landform and hydrology have been modified significantly by a network of channels draining the catchment. This system drains water flow through the Reserve to the Broadwater section of the Richmond River. Five main drains converge within the Reserve with their outlet at the Bagotville barrage (see map 2). The barrage operates as the main flow control structure and also restricts tidal backflow. Consequently there is no longer an incursion of estuarine (saline) water from the Richmond River into the Reserve.

The drainage system has lowered the water table, exposing acid sulfate soils that have developed through oxidation of iron pyrite. As a result of the modified hydrology the Reserve is relatively “dry”, however, during wet periods there can be large areas of ponded water. The drains maintain a permanent water flow through the Reserve.

## Native flora and fauna

The Reserve maintains a native vegetation cover except for disturbance along the drains and the two lots to the north-west which were previously cleared, are unfenced and currently grazed by cattle. As state earlier, the Bagotville barrage has led to the former estuarine environment in the Reserve, upstream of the barrage, being replaced by a freshwater environment. Consequently mangroves have been replaced by melaleucas.

Using Goodrick’s (1970) classification three habitat types occur in the Reserve:

- Melaleuca swamp forest is dominated by broad-leaved paperbark (*Melaleuca quinquenervia*) and interspersed with swamp oak (*Casuarina glauca*). This community covers most of the Reserve and occurs as:
  - closed, dense young forest without any undergrowth (regeneration following the 1977/78 fire);
  - closed mature forest with an understorey of rainforest elements, particularly cabbage palms (*Livistona australis*);
  - open forest with a ground layer of sedges and ferns;
  - woodland with a ground layer of sedges; and
  - open woodland (Specht 1974).

- Seasonal fresh swamp dominated by spike rush (*Eleocharis equisetina*), Juncus (*J. polyanthemus*) and water couch (*Paspalum distichum*) or common reed (*Phragmites australis*) occupies the former estuarine area upstream of the Bagotville barrage.

- Fresh meadow is dominated by knotweeds and smartweeds (*Persicaria spp*.) and by water couch or juncus in wetter places. This community occurs on the northern portions.

The axe breaker (*Geijera paniculata*), which is a rainforest species found in the understorey of the Melaleuca swamp forest in the Reserve, is listed as endangered under the *Threatened Species Conservation Act 1995* (TSC). Other threatened flora potentially occurs in the Melaleuca swamp forest, although further surveys are necessary to determine their presence. Semi-aquatic grasses and herbs with substantial quantities of the exotic cape water lily (*Nymphea capensis*) border the drains.

Since a comprehensive flora survey has not been undertaken for the Reserve, updated knowledge of existing vegetation is necessary to identify further endangered species or communities. This survey work should also be undertaken so that the effects of the proposed opening of the barrage gates on existing vegetation can be assessed (refer to *Tidal barrage* section below).

NPWS surveys in 1994 and 1995 and observations in 2000 identified more than 100 bird species, 14 mammals and 10 species of reptiles and amphibians as occurring in the Reserve. Amongst these 12 threatened fauna species were recorded (see table below).

| Common Name | Scientific Name | Status |
|---|---|---|
| **Mammals** | | |
| common planigale | *Planigale maculata* | V |
| koala | *Phascolarctus cinereus* | V |
| yellow-bellied sheath-tailed bat | *Saccolaimus flaviventris* | V |
| little bent-wing bat | *Miniopterus australis* | V |
| greater broad-nosed bat | *Scoteanax ruepellii* | V |
| **Birds** | | |
| magpie goose | *Anseranas semipalmata* | V |
| bush-hen | *Amaurornis olivaceus* | V |
| black-necked stork | *Ephippiorhynchus asiaticus* | V |
| brolga | *Grus rubicunda* | V |
| comb-crested jacana | *Irediparra gallinacea* | V |
| osprey | *Pandion haliaetus* | V |
| red goshawk | *Erythrotriorchis radiatus* | E1 |

E1 Endangered species under the TSC Act.
V Vulnerable species under the TSC Act.

The grey-headed flying fox (*Pteropus poliocephalus*), which depends on the Melaleuca swamp forest in the Reserve, is currently being proposed for listing as vulnerable.

The Reserve comprises habitat for some 20 species of frog.

## Cultural Heritage

The Reserve forms part of a landscape important to the local Aboriginal people, however no Aboriginal sites have been recorded in the Reserve. A number of bora rings and a cave drawing site are recorded nearby (Steel 1994), confirming Aboriginal use of the area before European settlement, and systematic surveys may find sites in the Reserve. The Ngyabul and Widjabul People of the Bundjalung Nation have shown interest in the Reserve.

The Reserve lies within the areas of the Far North Coast Regional Aboriginal Land Council and the Ngulingah and Jali Local Aboriginal Land Councils.

The drains within Tuckean Swamp are of historic interest. The drains were constructed to remove water from the surrounding farmland. They reflect the development of the Tuckean Swamp from 1888, when farmer Henderson dug the first drain, to the current day. The major drains within the Reserve were constructed from 1912–1915, with subsequent additions and the enlargement of some drains in 1968.

## Visitor Use

Visitor use of the Reserve is limited, with low levels of bird watching and canoeing being the main activities undertaken. The Reserve can be accessed from the Bagotville barrage (where canoes can be launched), however, the surrounding rural properties restrict public access. There are no formal walking tracks within the Reserve, but limited pedestrian access can be gained along the banks of Main and Stony Island drains. A small area for parking is located near the barrage.

The Richmond Valley Shire Council provides visitor facilities on the nearby Richmond River, including a boat ramp, wharf, toilets and fireplaces.

# THREATS TO RESERVE VALUES

## Drainage

Prior to the major changes to the hydrology of the floodplain, the Tuckean Swamp area would have comprised large areas covered with mangroves and saltmarsh that would have supported significant terrestrial and aquatic communities. The drainage of the swamp has had a significant impact on these communities locally and downstream in the Richmond River. The modification to the natural drainage system, through the construction of drains, began during the 1880s. The drains remove surface water from the surrounding farmland, resulting in a drier environment in the Reserve. The direct and indirect impacts of the drains continue to threaten the values of the area.

In addition, the draining of the swamps has changed the vegetation on the floodplain and in the back swamps, including loss of flood tolerant species. During floods the vegetation in these inundated areas dies and decays resulting in deoxygenated flood water which is recognised as a major factor contributing to major fish kills in the Richmond River.

As a result of lowering the water table there has been the exposure of acid sulfate soils of the former swamps. Soil acidification is caused by the oxidation of iron pyrite to produce sulfuric acid on exposure to air. During high rainfall events, acid is washed into the drains and ground water. This can lead to very acidic conditions with levels as low as pH 2-3 (Sammut 1996). It would appear that little aquatic life survives such events with the apparent exception of eels.

The loss of habitat for waterbirds and amphibians as a result of the reduction and acidification of wetlands and water bodies is a further consequence of these drainage operations. Before the drainage system was established, the Tuckean Swamp was known as one of the most significant breeding and feeding grounds for waterbirds on the NSW coast (Goodrick 1970, Baldwin 1996).

As the ground-water level dropped following the original drainage works, the peaty soil, which formerly covered extensive areas of the Reserve, dried out. The dry organic soils, or peats, subsequently became prone to fires which are difficult to control because they smoulder underground.

The input of nutrients and weeds from surrounding grazing lands, via the drainage system into and through the Reserve, is a significant consideration as it allows introduced plants to flourish at the expense of native species.

The Richmond River County Council is the authority responsible for the maintenance of the drains. The drains are cleared periodically to ensure the quick passage of floodwater and to reduce periods of inundation in the surrounding agricultural areas. A weed cutter, operated from a catamaran, is used to reduce weed growth in the drains. The drains are excavated as required and the drain banks slashed or sprayed with herbicides to keep them clear of vegetation. These operations will need to be conducted in a manner that does not threaten Reserve values, such as impacting on

water quality and aquatic habitat by increasing sediment loads, turbidity, and chemical contamination.

The retention of the riparian vegetation along the drains has substantial benefits for the Reserve, including increased bank stability, decreased erosion, lower water temperatures, higher dissolved oxygen, nutrient removal, lower turbidity, decreased acidity and increased fish habitat.

## Tidal barrage

The Bagotville barrage was constructed 30 years ago to prevent tidal intrusion onto the farmland upstream from the Reserve. The barrage comprises culvert flapgates which close at high tide, preventing tidal flow upstream into the Reserve. When there is sufficient water pressure upstream, normally during or after heavy rainfall or on low tide, the gates open, allowing drain water to flow into the Richmond River via the Broadwater.

Upstream of the barrage, former estuarine habitat has been replaced by freshwater habitat as result of the barrage operation. Melaleucas have replaced mangroves and associated estuarine vegetation (refer to *Native flora and fauna* section above). The implications for the various freshwater communities (including any endangered species) of opening the floodgates on the barrage to allow tidal flushing of the Reserve are yet to be determined in a Review of Environmental Factors (REF) currently being undertaken by the Richmond River County Council (RRCC).

The acidification upstream of the barrage, within the Reserve, has increased since this structure was put in place. The saline tidal water would normally act against acidifying conditions with its neutralising, diluting and flushing effects.

During high intensity rainfall events, when the water level in the swamp rises, significant volumes of acidic water can flow into the Broadwater via the drainage system causing fish kills.

A trial has been proposed by RRCC and NSW Fisheries to modify the tidal regime by manipulating the flood gates so as to enhance the ecological values of the waterways. The aim of the trial is to improve water quality and aquatic habitat within the Reserve and downstream of the barrage.

## Introduced species

Cattle, and occasionally horses, have been observed grazing in the Reserve for many years. Grazing, stock trampling and eutrophication are serious problems in the Reserve. Using the drains as a drinking place, stock have trampled down the banks in several places, resulting in soil erosion and high levels of sediment in the drains. Along the water courses trampling can disturb acid sulfate soils resulting in additional acidification. On the drain banks, and even in dense Melaleuca forest, the ground is littered with cow pats which raise nutrient levels in the soil and water. In turn this encourages weeds and insects which attract cane toads. Carcasses of cows, which

get stuck in the boggy ground, further increase nutrient levels and pollute the water. The development of an understorey in the swamp forest is limited while cattle are grazing and trampling the Reserve.

There are reports of cane toads *(Bufo marinus)* and house mice *(Mus musculus domesticus)* in the Reserve. It is possible that the latter has become established at the expense of native rodents and marsupials. The diet of the cane toad includes insects, principally beetles, but several species of small snakes, lizards, frogs and even small marsupials are also reputedly eaten.

The cape water lily (*Nymphea capensis*), a species native to South Africa, is an abundant weed in the drains throughout the Reserve and occupies much of the water body immediately upstream of the barrage, providing habitat for the comb-crested jacana (*Irediparra gallinacea*). Measures to control this weed need to take the requirements of the jacana into account. Lantana *(Lantana camara)* and morning glory *(Ipomoea quamoclit)* have also been recorded in the Reserve.

A comprehensive study of introduced flora and fauna, including their impacts on the Reserve environment, is desirable.

# MANAGEMENT OBJECTIVES

## General objectives for nature reserves

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

- protection and preservation of scenic and natural features;
- maintenance of natural processes as far as it is possible;
- conservation of wildlife;
- preservation of Aboriginal sites and historic features;
- protection of catchment values;
- identify the natural and cultural values of the Reserve through appropriate surveys; and
- encouragement of scientific and educational inquiry into environmental features and processes.

Nature reserves, unlike national parks, do not include provision of recreation opportunities as a management objective.

## Specific management objectives for Tuckean Nature Reserve

In addition to the above, specific management objectives for the Reserve are as follows:

- manage the Reserve as part of a regional network of wetland reserves;
- manage the Reserve as a dynamic, evolving landscape due to the hydrological changes of the area;
- conserve and protect the Reserve's threatened flora and fauna and regionally significant species;
- allow the succession of rainforest species in some sections of the Reserve while recognising the need to protect Melaleuca swamp forest;
- maintain a hydrological regime that minimises the acidification of waters in the Reserve and aims at generally improving the quality of waters discharged from the drainage network;
- provide for the re-establishment of mangrove communities by changing the management of the tidal barrage to restore tidal regimes; and
- minimise introduced species and exclude domestic stock from the Reserve.

# MANAGEMENT STRATEGIES

| Management Considerations | Desired Outcomes | Strategies and Actions | Priority |
|---|---|---|---|
| ***Hydrology and Soil***<br>Increasing acidification in the Tuckean Swamp requires changes to the hydrological regime through better management of the barrage. Taking advantage of the neutralising, diluting, and flushing effects of tidal water, controlled tidal back-flow into the Reserve by opening a gate of the barrage is being considered. A Review of Environmental Factors (REF) is currently being undertaken by the Richmond River County Council (RRCC) at the request of NPWS to assess the impacts of this proposal on the ecology of the Reserve. Input from NSW Fisheries will be sought on the REF.<br><br>Drain and bank maintenance practices used by RRCC to control weeds in the Reserve include cutting and removing aquatic weeds with a bucket attached to an excavator designed so as to minimise disturbance to sediments. Weeds are also sprayed with registered herbicides. Drain maintenance does not require dredging or deepening. | • A hydrological regime is established that minimises further soil acidification in the Reserve.<br>• Soil disturbance and erosion are minimised.<br>• Drain maintenance works do not threaten Reserve values.<br>• Changes to the hydrology limit adverse effects on the Melaleuca swamp, while mangroves are permitted to re-establish in the lower reaches of the Reserve.<br>• Water quality and aquatic habitat values are enhanced, both within the Reserve and downstream of the barrage. | • Seek the cooperation of the RRCC and NSW Fisheries to manage the barrage so that, based on the REF, the Reserve's ecology and aquatic habitat is enhanced.<br>• Undertake joint research with RRCC and NSW Fisheries before and after there are changes in the barrage management.<br>• Enter into a drain maintenance agreement with the RRCC and issue a licence to them to undertake works in accordance with the agreement.<br>• Inform the RRCC that the use of herbicides in the Reserve must be negotiated with the NPWS.<br>• Support RRCC to determine maintenance strategies to improve the management of the drains.<br>• Monitor the flora and fauna before and after the proposed change in barrage management.<br>• If excavation of drains is unavoidable, the spoil must be disposed of in a manner that does not adversely impact on the Reserve or other sensitive areas within the catchment.<br>• Drain banks that are degraded by cattle trampling will be repaired to prevent further soil erosion. | High<br><br>High<br><br>High<br><br>High<br><br>High<br><br>Medium<br><br>Medium |

| Management Considerations | Desired Outcomes | Strategies and Actions | Priority |
|---|---|---|---|
| ***Native Flora***<br>A large proportion of the Reserve is covered by Melaleuca swamp forest, partially rejuvenated by fire south of Stony Island drain. To the north of the latter, mature Melaleuca forest with rainforest elements occurs, including threatened species such as the axe breaker.<br>In the Reserve, cattle trampling and grazing have impeded regeneration of Melaleuca swamp forest. | • Increased knowledge of existing flora and its ecological requirements.<br>• The diversity of existing native flora is maintained.<br>• There is no loss of native species or habitat for threatened and regionally significant flora.<br>• Revegetation of cleared and degraded areas. | • A vegetation survey will be undertaken to determine the effects of changes to the hydrology of the Reserve.<br>• Encourage research into the ecological requirements of native flora in the Reserve.<br>• Cattle and other domestic stock will be excluded from the Reserve through improved boundary fencing.<br>• The use of herbicides in the Reserve will be minimised, and where used will be directed to minimise effects on non-target vegetation and waterways.<br>• Regrowth of vegetation following the exclusion of cattle from the Reserve will be monitored. | High<br>High<br>High<br>High<br>Low |
| ***Native Fauna***<br>The Reserve supports at least 12 threatened fauna species (seven birds and five mammals including three bats), many of which depend on Melaleuca swamp forest and/or open water bodies. The Reserve provides habitat for a large number of bird species and supports several bat species which roost and breed in old hollow Melaleuca trees. | • Diversity of existing native fauna is maintained.<br>• There is no loss of native species or habitat for threatened and regionally significant fauna.<br>• Native fauna is not adversely affected by changes to the hydrological regime. | • Research into the ecological requirements of native fauna in the Reserve will be encouraged.<br>• The impacts of changes to the hydrological regime on the fauna of the Reserve will be monitored. | Medium<br>Medium |

| Management Considerations | Desired Outcomes | Strategies and Actions | Priority |
|---|---|---|---|
| ***Introduced Flora and Fauna***<br>The exotic cape water lily is abundant in the drains throughout the Reserve and areas of infestation are expanding.<br><br>Cattle illegally graze in the Reserve, causing damage and degradation to the environment, the drains and the drain banks through trampling and nutrient enrichment. Some boundary fences are in poor condition or non-existent, allowing for stock incursions.<br>Cane toads and house mice have been reported for the Reserve, current numbers are unknown. | • Pest species are identified and appropriate strategies undertaken for their control and monitoring.<br>• Weed control does not affect indigenous flora and fauna particularly threatened species.<br>• Cattle are excluded from the Reserve. | • Erect Reserve boundary signs at appropriate locations where necessary to identify the boundary.<br>• Enter into boundary fencing agreements with neighbours according to the NPWS fencing policy.<br>• Seek cooperation of Reserve neighbours to control their stock and other domestic animals.<br>• Prepare a pest species management plan for the Reserve.<br>• Seek cooperation of RRCC to reduce drain bank clearing in order to diminish cane toad habitat.<br>• Progressively remove cape water lily in small sections so as to retain jacana habitat, allowing replacement with native species where possible.<br>• Seek and implement strategies to control the cane toad population.<br>• Encourage monitoring of cane toad and house mouse populations to ascertain whether pest management strategies are working. | High<br><br>High<br><br>High<br><br>High<br><br>High<br><br>Medium<br><br>Medium<br><br>Medium |
| ***Cultural Heritage***<br>No Aboriginal sites have been recorded in the Reserve, although Aboriginal use of the area has been reported.<br><br>The drains reflect the history of the last 100 years of agricultural use of the Tuckean swamp, but none of the original drains remain intact in the Reserve. | • Any cultural heritage sites in the Reserve are recorded and protected in consultation with the local indigenous community where appropriate. | • Encourage the involvement of the local indigenous and non-indigenous communities in the identification and protection of any cultural heritage sites that may be identified.<br>• Precede all works with the potential to impact on Aboriginal sites by a site survey and assessment of the impact on Aboriginal cultural heritage.<br>• As opportunities arise, progressively survey for cultural heritage sites within the Reserve. | High<br><br>High<br><br>Medium |

| Management Considerations | Desired Outcomes | Strategies and Actions | Priority |
|---|---|---|---|
| ***Fire Management***<br>The Reserve was significantly degraded by a major wildfire in 1977 and subsequent fires have also had a detrimental affect on Reserve values. Most fires affecting the Reserve have originated on adjoining properties. No wild fires have been recorded in the Reserve since 1991. Melaleuca ignites easily and its morphology allows fire to spread quickly through burning bark being carried about by the wind. Resulting from the drainage works the peat supporting the Melaleuca forest is now relatively dry and susceptible to fire. Peat fires can smoulder for months under the ground, resulting in invisible hollows in the ground and widespread tree falls. Such fires can only be extinguished by flooding with very large quantities of water. The last peat fire in the Reserve area occurred from mid August 1977 to end of March 1978. This fire was ignited by the escape of a nearby burn-off.<br><br>Fire and fire suppression activities can also impact on native fauna and damage cultural heritage items such as Aboriginal scarred trees.<br><br>The risk of further degradation by future fires in the short and medium term (up to 20 years) is high. | • Fire is excluded from the Reserve.<br>• The Reserve and its surrounding areas are cooperatively managed to prevent fire.<br>• Cultural heritage items are not damaged as a result of fire or fire suppression activities. | • Prepare a fire management plan for the Reserve.<br>• Cooperate with neighbours and RRCC in identifying and utilising existing infrastructure to control wildfire, including pumping water from the estuary/drains to extinguish burning peat.<br>• Promote strategies on adjoining properties to minimise the escape of fire into the Reserve.<br>• NPWS will continue to promote a cooperative approach to fire management with landholders and brigades for the protection of property and the natural and cultural heritage values of the Reserve.<br>• Increase patrols of the Reserve during periods of high fire danger. | High<br><br>High<br><br>High<br><br>High<br><br>High |

| Management Considerations | Desired Outcomes | Strategies and Actions | Priority |
|---|---|---|---|
| ***Research and Monitoring***<br>The Reserve has potential for scientific and educational studies. The results of these studies would also be of value for management of the Reserve.<br><br>Research and monitoring are considered to be important for the Reserve in relation to:<br>- rainforest encroachment into Melaleuca swamp forest;<br>- rehabilitation after fire;<br>- effects of water quality changes following the proposed changes to the barrage with resultant tidal flushing;<br>- improving knowledge of the flora and fauna and habitat requirements in the Reserve;<br>- improving knowledge of Aboriginal cultural heritage sites and places; and<br>- control of introduced species. | • Increased knowledge of the Reserve's history, its habitats, flora and fauna communities and their ecological requirements is obtained.<br>• Research and monitoring will direct management activities on the Reserve and provide feedback on the success of control programs. | • Encourage researchers and educational institutions to use the Reserve for appropriate educational and research purposes.<br>• Encourage researchers and educational institutions to pursue the following research topics in particular:<br>i. Terrestrial vegetation survey;<br>ii. Ecology of the Melaleuca swamp forest;<br>iii. Introduced fauna (control techniques, mapping, distribution, etc.);<br>iv. Identification and mapping of weeds;<br>v. Aquatic flora and fauna survey;<br>vi. Entomology survey;<br>vii. Fauna surveys, preferably of bats (distribution and usage), frogs (identification and distribution), reptiles (identification and distribution), wading birds (migration), and mammals.<br>• Encourage research into potential Aboriginal sites and places in the Reserve. | High<br><br>High<br>High<br>High<br><br>Medium<br>Low<br>Low<br>Medium<br><br>Medium |
| ***Visitor Use***<br>The Reserve is used by a small number of bird watchers and canoeists, however, visitor facilities are not provided in the Reserve. Access by small boat is possible at the barrage. | • Visitor use does not impact on the Reserve.<br>• The ecology and threatening processes of the Reserve are interpreted. | • Visitor facilities will not be provided in the Reserve.<br>• To minimise disturbance to birds, powerboats will be prohibited except for emergencies and approved management and research purposes.<br>• Interpretation of the Reserve values and threats to these values will be provided near the barrage. | High<br><br>High<br><br>Medium |

**Legend for priorities**

**High** priority actions are those that are imperative to the achievement of management objectives identified in this Plan and need to be implemented in the near future to prevent degradation of the natural and cultural values or physical resources of the Reserve, significant costs associated with rehabilitation at a later date, and/ or unacceptable risk to the public.
**Medium** priority actions are those that are necessary to achieve management objectives but will be implemented as resources become available because the time frame for their implementation is not urgent.
**Low** priority actions are desirable to achieve management objectives but can wait until resources become available.

## REFERENCES:


Baldwin, J. (1996). *Draft Land and Water Management Plan for Tuckean Swamp,* and Technical Appendices. Richmond River County Council, Unpublished Report.

Boland, D.J. et al. (1984). *Forest Trees of Australia*. CSIRO, East Melbourne.

Earley, O. (1999). *Richmond River Catchment – Wetlands Inventory*. Richmond Catchment Management Committee, Alstonville.

Goodrick, G.N. (1970). *A Survey of Wetlands of Coastal New South Wales*. Tech. Memorandum. No.5, CSIRO, Canberra.

Morand, D.T. (1994). *Soil Landscapes of the Lismore-Ballina 1:100 000 Sheet* Report. Soil Conservation Service of NSW, Sydney.

NPWS, Lismore District (1978). *Summary of the proceedings of the informal meeting to discuss the Tuckean Swamp Fire, Fire Season 1977/78, Lismore*. Internal file F/0219, NSW NPWS, Alstonville.

Resource and Conservation Assessment Council (1996). *Regional Report of Upper* North East NSW, Vol.4: Biodiversity Attributes. NSW Government, Sydney.

Richmond River County Council (1999), *Bagotville Barrage Operational Strategy: Report on Management Options*. Prepared by John Wilson and Partners in association with IGC and Associates Pty Ltd.

Sainty, G.R., Jacobs, S.W.L. (1981). *Water Plants of New South Wales*. Water Resources Commission NSW, Sydney.

Sammut, J (1996*). Processes and Impacts of Soil and Water Acidification in Tuckean Swamp, Lower Richmond River, Northern NSW.* University of NSW, Sydney.

Specht, R.L., et al (1974). *Conservation of major plant communities in Australia and Papua New Guinea*. Aust. J. Bot., Suppl. Series No. 7.

Steele, J.G. (1994). *Aboriginal Pathways in Southeast Queensland and the Richmond River.*


## FURTHER INQUIRIES:

Inquiries about Tuckean Nature Reserve or this plan of management should be directed to the Richmond River Area Office, Colonial Arcade, Alstonville, on (02) 6627 0200.