Mambo Wetland
Plan of Management

January 2006

Port Stephens
C·O·U·N·C·I·L
...a community partnership

Acknowledgements

Numerous people have been involved in the development of this Plan of Management, all of whom deserve acknowledgement for their contributions.

Thanks go to all members of the Mambo Wetland Steering Committee, (listed in Table 2 of this document) who have provided significant direction and assistance in the preparation of the Plan of Management. Special thanks go to dedicated members of the Mambo/Wanda Wetlands Reserve and Landcare 355(b) Committee and representatives of the Maiaangal people, particularly Carol Ridgeway-Bissett, for volunteering time and contributing extensive local knowledge to the Plan of Management.

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TABLE OF CONTENTS

SECTION A: Background to Existing Environment

SECTION B: Management Plan

APPENDICES

FIGURES

TABLES

MAMBO WETLANDS
PLAN OF MANAGEMENT

Section A: Background to Existing Environment

1.0 INTRODUCTION

Mambo Wetland, part of the Port Stephens Estuary, is situated primarily in Salamander Bay. It is registered as a SEPP 14 wetland, and as such has significant ecological values that warrant conservation. The wetland carries out a number of important processes, some of which include the uptake of nutrients and sediment to maintain healthy water quality, provision of diverse habitat for a range of flora and fauna species as well as regulation of water flows within the catchment.

This Plan of Management has been developed by Port Stephens Council with the assistance of a grant provided by the Environmental Trust. A Mambo Wetland Steering Committee was established to provide assistance and guidance in the process of developing the Plan.

The purpose of the plan is to develop a framework for the future management of the wetland to conserve its important natural values, whilst ensuring that the interests and safety of the community are protected. The plan has been developed with the intent that Council staff, members of the community and other external stakeholders will jointly implement the strategies.

This Plan has been divided into two major sections. The first section provides a background to the existing environment, describing the location of the wetland and the natural and culturally significant values offered. It also describes the flora and fauna and other features of the natural environment. The second section of the plan addresses the issues identified by the steering committee and through community consultation.

The main threats to Mambo Wetland have been identified as: invasion of exotic weed species, increased frequency of fire and the continual loss of fauna habitat due to clearing for development and urban drainage adding litter, excess nutrients and sediment to the wetland. The Plan addresses these issues and recommends strategies to minimise these threats, thus protecting the ecological values and culturally significant features of this important environment.

2.0 SITE DESCRIPTION

Mambo Wetland is an estuarine wetland situated primarily in Salamander Bay, Port Stephens, covering an area of 175ha. Figure 1 shows an aerial photograph of the reserve, while Figure 2 shows its location. Listed under State Environmental Planning Policy No. 14 (SEPP 14), Mambo Wetland supports a diversity of important vegetation communities, including Estuarine Saltmarsh and Mangroves, Woodland, Open Forest, Freshwater Gahnia Swamp Forest and Paperbark Swamp Forest. A full description of these communities is given in Section 6.

The reserve is predominantly zoned 7(a) Environmental Protection under the Port Stephens Council Local Environment Plan (LEP), 2000. The dominant land use surrounding the wetland is residential development, zoned as 2(a) Residential. The LEP land zoning information is included on the map in Figure 2.

Mambo Wetland is part of the Port Stephens Estuary, which has been listed on the Register of the National Estate. The Port Stephens Estuary contains the largest area of mangroves (2,700ha), the second most extensive area of seagrass (1,000ha) in New South Wales and a significant area of saltmarsh (1,400ha). These communities are in a good condition and are prime examples of these vegetation types in northern New South Wales. They are also important for maintaining regional fish, prawn and crab populations. The area is an important feeding and staging area for migratory waders, and is considered to be one of the six most important wader habitats of coastal New South Wales. As an integral part of the Port Stephens estuary, the conservation significance of Mambo Wetland is high.

The Mambo Wetland site comprises six parcels of community land. The relevant parcels are:

- Lot 1 DP 844484 Zoning 7(a)
- Lot 567 DP 27353 Zoning 7(a)
- Lot 103 DP 860500 Zoning 7(a)
- Lot 104 DP 860500 Zoning 2(a)
- Lot102 DP 860500 Zoning 6(a)
- Lot 101 DP 860500 Zoning 6(a)

3.0 WETLAND VALUES

Increasingly, the value of wetlands and the important processes they carry out are being acknowledged. Recognising these values of Mambo Wetland provides a framework for the protection and conservation of this significant natural environment.

Wetlands can offer environmental, social, aesthetic and economic values. Mambo Wetland is a healthy and relatively pristine ecosystem, and therefore offers many values from each of these categories, including:

- Provision of breeding areas for fish, frogs and other aquatic life,
- Important habitat for a diverse range of birds, including migratory and wading birds,
- Diversity of habitat supporting a diversity of flora and fauna not found in other environments,
- Aesthetic qualities attract recreational activities such as bird watching, nature study, canoeing, boating, fishing and bushwalking,
- Improvement of water quality by absorption of nutrients and pollutants and settlement of sediment.
- Reduction in the severity of floods and droughts by retaining water and slowly releasing it.

Figure 1 - Mambo Wetland Aerial Photo - Photo taken Oct, 1998

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STUDY AREA EDGED IN YELLOW

SCALE
0 metres 400

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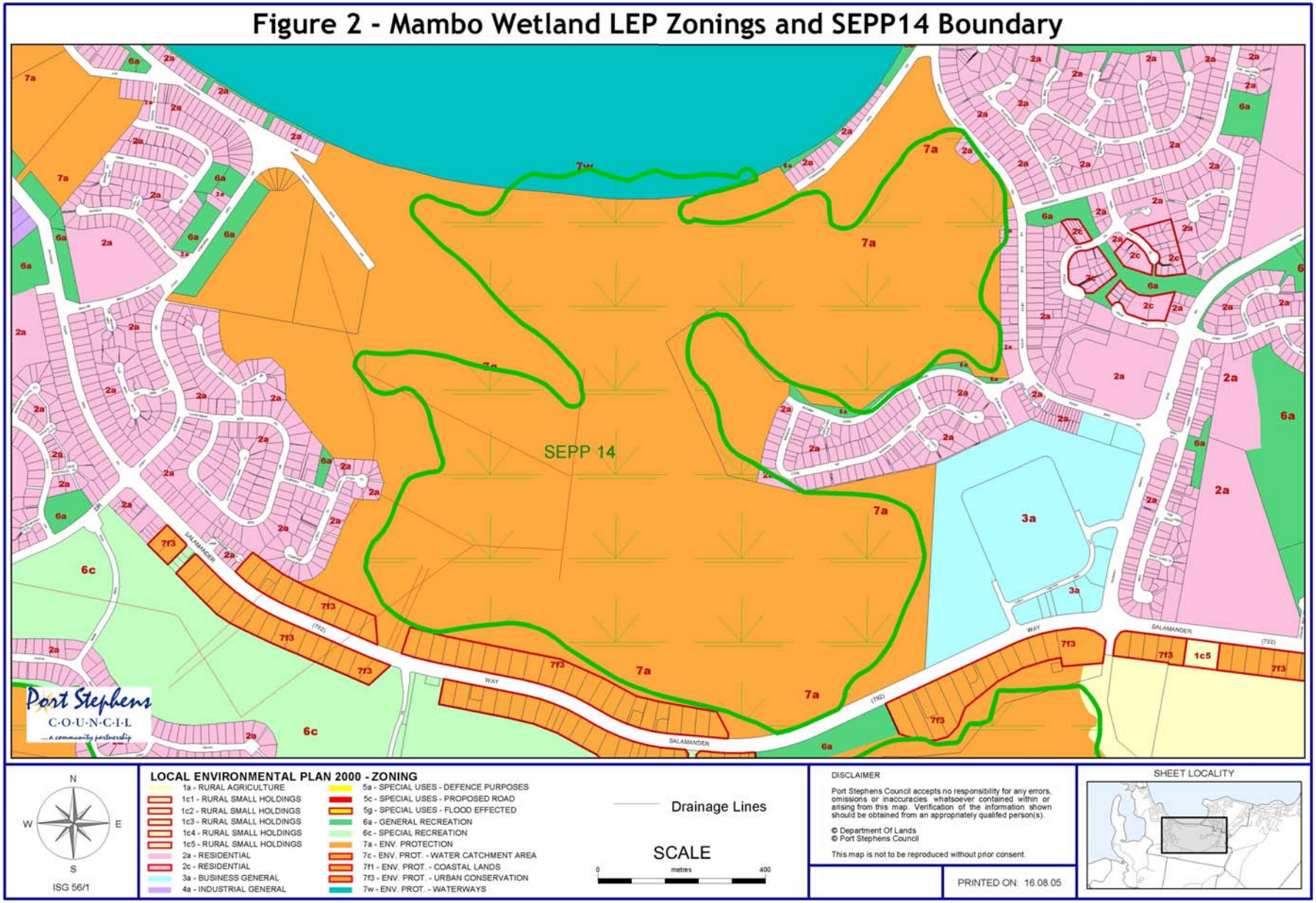
SHEET LOCALITY

Figure 2 - Mambo Wetland LEP Zonings and SEPP14 Boundary



- The basis for food chains that support large numbers of wetland birds, fish, insects, frogs, crustaceans and other life.
- Provision of opportunities for scientific research in a near pristine environment.

Mambo Wetland is a natural retention basin acting as a flood mitigation system preventing large scale flooding of Salamander Bay (Econetwork, 1993). The wetland system also filters sediment and nutrients from the water before it enters Salamander Bay, maintaining healthy water quality.

The shallow waters of Mambo Wetland offer tadpoles protection from predators such as fish that inhabit more permanent waters. For this reason the wetland is important breeding habitat for a range of frog species.

As Mambo Wetland is a relatively pristine, well conserved ecosystem, it provides opportunities for scientific study. The results of this research can be used to help guide the regeneration of disturbed wetland systems. With the increasing recognition that wetlands have a number of important roles, this research may also be useful in the design of purpose built, constructed wetlands.

4.0 SITE HISTORY

The natural environment of Mambo Wetland was previously a much larger area; however it has been greatly reduced due to the encroachment of urban development. Many studies have been undertaken into the development potential of Mambo Wetland, however, nothing has ever come to fruition. At present, the wetland and surrounding bushland is zoned as 7(a) Environmental Protection. Some development is permitted within this zoning category, but this must be compatible with the objectives of the zone.

Records reveal that extensive drainage canals were dug through Mambo Wetland in the 1890's and early 1900's, which significantly altered the natural water regime of the wetland (Econetwork, 1993).

Mangroves occur at the northern edge of the wetland which naturally should receive tidal inundation from Salamander Bay via Mambo Creek. However, in 1955 a sealed road was constructed between the wetland and the bay restricting tidal inundation, hence threatening the health of the mangrove community. Tidal inundation to the mangroves is now relying solely on two artificial culverts that connect the wetland with Salamander Bay.

Sandmining of the area began in 1970 (Econetwork, 1993). This process has significantly altered the natural topography of the wetland and sand dunes. As part of the rehabilitation process after mining, a number of areas have been filled with offsite material. Alterations to the layers of the terrestrial sand dunes associated with sand mining have altered the natural drainage pathways (McNair, 1985). Consequent alterations to the wetland hydrology are thought to have altered the vegetation associations present in the wetland (Econetwork, 1993). An example of this is the reduction in the area of mangroves and the increase in terrestrial vegetation including saltmarsh. This appears to be correlated with the infilling of the wetland. Further siltation from urban stormwater runoff may continue to displace the mangroves with replacement by terrestrial communities such as saltmarsh and sedge (GHD, 1991).

The history of human disturbance has resulted in the loss of a range of species that once occurred at Mambo Wetland. For example, jabirus, brolgas and emus were once present, but have not been recorded for many years (Econetwork, 1993). Without adequate conservation measures, the flora and fauna of Mambo Wetland will continue to decline.

5.0 FLORA METHODOLOGY

5.1 Floristics

A flora list of Mambo Wetland was compiled with data obtained from field surveys and literature reviews. The field surveys consisted of random, walk-over surveys, which covered a large proportion of the wetland area. This involved identifying each new species encountered while walking randomly through the vegetation.

The literature review involved a search of the National Parks and Wildlife Service (NPWS) Wildlife Atlas for flora species recorded at Mambo Wetland and areas within close proximity. In addition, a list of flora species likely to occur at Mambo Wetland was compiled from a study of the Flora of Port Stephens and Myall Lakes undertaken by Don McNair in 1992.

The data collected from the field surveys and the literature review has been compiled to produce a complete species listing of the flora of Mambo Wetland, which appears in Appendix 1.

5.2 Vegetation Communities

Several different vegetation communities occur within Mambo Wetland which can be categorised by the dominant canopy species, characteristic ground layer species, height of the tallest trees and percentage foliage cover. The vegetation communities identified in the Lower Hunter & Central Coast Regional Environmental Management Strategy (LHCCREMS) mapping (NPWS, 2000) were used as a guideline for the categorisation of the communities occurring in Mambo Wetland.

6.0 FLORA RESULTS

6.1 Floristics

The species list for Mambo Wetland found in Appendix 1 includes species both from reviews of previous studies and the results of ground-truthing vegetation surveys. It should be noted that although this list may not include every species occurring in the wetland it adequately records the majority of species occurring. The fire of January 2003 may also be responsible for not recording species that were present prior to the fire.

6.2 Vegetation Communities

Based on these characteristics, seven vegetation communities have been described for Mambo Wetland. The map in Figure 3 shows the extent of each of these vegetation communities.

6.2.1 Estuarine Mangrove Complex

An estuarine mangrove system occurs at the interface of the wetland and Salamander Bay. This community is subject to tidal inundation from Salamander Bay via Mambo Creek, however this has been impeded due to the presence of Foreshore Drive.

This community is dominated by the Grey Mangrove (*Avicennia marina*). The River Mangrove (*Aegiceras corniculatum*) is also present but occurs in the less inundated areas closer to shore. In some areas Native Reed (*Phragmites australis*) occurs in association with the mangroves. There is little diversity in the mangrove community due to the marginal environment in which it occurs. Mangroves have aerial roots called pneumatophores which are special adaptations allowing the plants to survive in an environment that is regularly inundated by water.

Figure 3 - Mambo Wetland - Vegetation Communities 2003

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1. Estuarine Mangrove Complex
2. Freshwater Wetland Complex
3. Swamp Mahogany - Paperbark Forest
4. Coastal Sand Apple - Blackbutt Forest

Cycleways
Drainage Lines

SCALE
0 metres 400

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SHEET LOCALITY

Figure 4: Estuarine Mangrove Complex

6.2.2 Estuarine Saltmarsh Complex

The Estuarine Saltmarsh community occurs behind the Estuarine Mangrove community, and consequently receives slightly less saltwater inundation from the bay. A few scattered mangroves (*Avicennia marina*) are present in this community although this is not as abundant as in the Estuarine Mangrove Community. The vegetation cover is relatively sparse in the saltmarsh, and is characterised by low growing ground covers and sedges. The dominant species occurring in the saltmarsh community is Samphire (*Sarcocornia quinqueflora*) with other estuarine species occurring in less abundance.

Figure 5: Estuarine Saltmarsh Complex

6.2.3 Mahogany/Paperbark Swamp Forest

The Mahogany/Paperbark Swamp Forest occurs as a buffer community around the majority of the wetland area as shown in Figure 3. The dominant canopy species are Swamp Mahogany (*Eucalyptus robusta*) and Broad-leaved Paperbark (*Melaleuca quinquenervia*). Swamp Mahogany is an important koala food tree. Other tree species that occur less frequently include Black She Oak (*Allocasuarina littoralis*), Smooth-barked Apple (*Angophora costata*) and Old Man Banksia (*Banksia serrata*).

The shrub-layer consists of wet sclerophyll species such as Coastal Wattle (*Acacia sophorae*), Smooth Geebung (*Persoonia levis*) and Black Wattle (*Acacia irrorata*). The ground layer is characterised by Swamp Water Fern (*Blechnum indicum*), Bracken Fern (*Pteridium esculentum*) and *Leptospermum spp.* In wetter areas, cyperoid species such as Saw Sedge (*Gahnia sp.*) occur (Figures 6 & 7).

Figure 6: Mahogany/Paperbark Swamp Forest

Figure 7: Shows the abundance of Cyperoid species in the understorey of Mahogany/Paperbark Swamp Forest community in wetter areas.

6.2.4 Coastal Sand Woodland

The Coastal Sand Woodland is found in one area of the wetland, at the end of Worimi Drive and behind the residences of Mariner Crescent (Figure 3). It also occurs behind Salamander Bay Shopping centre, but this patch is highly disturbed. The community occurs on higher ground and is not subject to inundation, hence the vegetation is characterised by species adapted to drier conditions.

The dominant canopy species in the Coastal Sand Woodland include Smooth-barked Apple (*Angophora costata*), Forest Red Gum (*Eucalyptus tereticornis*) and Blackbutt (*Eucalyptus pilularis*). The threatened species Parramatta Red Gum (*Eucalyptus parramattensis*) is also present in this community. These canopy species are important koala food trees. The sub-canopy is dominated by Old Man Banksia (*Banksia serrata*). The shrub-layer consists of coastal sclerophyll species such as Coastal Wattle (*Acacia sophorae*), Geebung (*Persoonia lanceolata*) and Black She Oak (*Allocasuarina littoralis).*

This community occurs in an area that was previously sand mined and shows evidence of this disturbance. The understorey is sparse and has been invaded by weeds such as Bitou Bush (*Chrysanthemoides monilifera*) and Lantana (*Lantana camara*). Native species occurring in the understorey include a range of Fabaceae species, *Hibbertia spp.*, Kangaroo Grass (*Themeda triandra*), Flax Lily (*Dianella caerulea*), Spotted Sun Orchid (*Thelymitra ixioides*) and Mat Rush (*Lomandra longifolia*). Pig Face (*Carpobrotus glaucescens*) is colonising the sand dunes in some areas.

Figure 8: Coastal Sand Woodland

6.2.5 Freshwater Gahnia Swamp Forest

The Freshwater Gahnia Swamp Forest occurs in the low-lying areas of the reserve and is subject to the highest level of inundation. The dominant species in this community is Saw Sedge (*Gahnia sieberana*) while a true canopy layer is distinctly lacking. However, tree species do occur in scattered distribution and include Broad-leaved Paperbark (*Melaleuca quinquenervia*) and Swamp Mahogany (*Eucalyptus robusta*).

Other species occurring in the understorey of the Freshwater Gahnia Swamp Forest include Swamp Water Fern (*Blechnum indicum*), Rapier Sedge (*Lepidosperma flexuosum*), Curly Wigs (*Caustis flexuosa*) and other cyperoid species.

Figure 9: Freshwater Gahnia Swamp Forest

6.2.6 Moist Coastal Apple Forest

Moist Coastal Apple Forest occurs in the north-west section of the reserve, as shown in Figure 3. While this vegetation community occurs on a moist, sandy substrate, it is generally drier than that of the swamp forest communities which occur on lower terrain.

The dominant canopy species in this community are Blackbutt (*Eucalyptus pilularis*) and Smooth-barked Apple (*Angophora costata*). Other canopy species occurring in less abundance include Red Bloodwood (*Corymbia gummifera*) and Rough-barked Apple (*Angophora floribunda*). Towards the ecotone between this community and the Mahogany/Paperbark Swamp Forest, Swamp Mahogany (*Eucalyptus robusta*) becomes more common.

In comparison to other vegetation communities within the reserve, the shrub layer of this open forest is considered more diverse. Characteristic species include Old Man Banksia (*Banksia serrata*), Lemon-scented Tea Tree (*Leptospermum polygalifolium*), Prickly Tea Tree (*Leptospermum juniperinum*), Pink Waxflower (*Eriostemon australasius*), Wedding Bush (*Ricinocarpus pinifolius*), *Hibbertia spp*., *Daviesia ulicifolia*, Bracken Fern (*Pteridium esculentum*), Rice Flower (*Pimelea linearifolia*) and Wild Parsnip (*Trachymene incisa*). A variety of ferns including Bracken Fern (*Pteridium esculentum*), Swamp Water Fern (*Blechnum indica*) Screw Fern (*Lindsea linearis*) and Mulga Fern (*Cheilanthes sieberi*) also occur.

Figure 10: Moist Coastal Apple Forest

Figure 11: Moist Coastal Apple Forest

6.2.7 Paperbark/Swamp Oak Complex

The Paperbark/Swamp Oak Complex fringes the Estuarine Mangrove Complex along Foreshore Drive. The community is characterised by Broad-leaved Paperbark (*Melaleuca quinquenervia*) and Swamp Oak (*Casuarina glauca*), and occurs on slightly higher ground than the mangroves. It is considered that the Paperbark/Swamp Oak Complex was previously a wider strip that extended up to the foreshore; however it has been reduced in size as a result of construction of Foreshore Drive.

As this vegetation community occurs along a roadside, it is highly disturbed which has resulted in the invasion of a number of weed species. Weeds present include Coral Tree (*Erythrina X sykesii*), Lantana (*Lantana camara*), Bitou Bush (*Chrysanthemoides monilifera*), Mother of Millions (*Bryophyllum delagoense*), Queensland Silver Wattle (*Acacia podalyrifolia*), Golden Wreath Wattle (*Acacia saligna*) and Pennywort (*Hydrocotyle bonariensis*).

7.0 FAUNA METHODOLOGY

7.1 Spotlighting

Three spotlight searches, each 1 ½ hours in length, were undertaken by an ecologist and members of the community. Spotlighting was carried out over a six-week period between September and October 2003.

It is recognised that only the minority of species were identified in the fauna surveys. This is due to the secretive nature of native fauna and the limited time available for undertaking surveys. In light of this, a search of the NPWS Wildlife Atlas was undertaken to identify species that have been recorded within the vicinity of Mambo Wetland. In addition, records have been noted from animal rescue organisations and other local volunteers familiar with the reserve. The fauna species list (Appendix 2) has been compiled from information obtained from the fauna surveys, literature review and personal accounts from local residents.

7.2 Call Playback

The calls of frog species expected to occur at Mambo Wetland were played in areas of likely frog habitats. After playing the call for 1 minute, the tape was stopped to listen for call-backs. Frog calls played included the Dwarf Green Tree Frog (*Litoria fallax*), Wallum Froglet (*Crinia tinula*), Striped Marsh Frog (*Limnodynastes tasmaniensis*), Spotted Marsh Frog (*Limnodynastes peronii*) and Common Eastern Froglet (*Crinia signifera*).

The calls of nocturnal bird species were also played. Calls played included Sooty Owl, Powerful Owl, and Masked Owl. Species recorded are listed in Appendix 2.

7.3 Bird Species

A bird species list has been compiled with the assistance of members of the Hunter Bird Observers Club, the Tomaree Bird Observers Club and Mambo/Wanda Wetlands and Landcare Committee.

8.0 FAUNA RESULTS

This list has been compiled from surveys undertaken by Port Stephens Council throughout 2003, as well as those species recorded on the NPWS Wildlife Atlas database. Fauna species observed by the Mambo/Wanda Wetland Committee are also included. A list of all fauna recorded or likely to occur in Mambo Wetland is given in Appendix 2.

Additionally, data has been used from community koala surveys undertaken in 1992 and 2004.

8.1 Mammals

A number of small mammals have been recorded in Mambo Wetland. Mammals observed during the spotlighting survey include Ringtail Possum (*Pseudocheirus peregrinus*), Brushtail Possum (*Trichosurus vulpecular*), Koala (*Phascolarctos cinereus*) and Grey-headed Flying Fox (*Pteropus poliocephalus*). Other mammals have been recorded at Mambo Wetland or the vicinity, such as Sugar Glider (*Petaurus breviceps*), Eastern Chestnut Mouse (*Mormopterus gracilicaudatus*) and a number of bat species.

8.2 Amphibians

A number of frogs were recorded during the survey. These included the Common Eastern Froglet (*Crinia signifera*), Dwarf Green Tree Frog (*Litoria fallax*), Striped Marsh Frog (*Limnodynastes tasmaniensis*) and Wallum Froglet (*Crinia tinula*). Approximately 22 different frog species have been recorded or are considered likely to occur in Mambo Wetland. These are listed in Appendix 2.

8.3 Birds

Due to the range of habitat at Mambo Wetland, a large diversity of bird species has been recorded. The 158 bird species recorded include water birds such as the Pacific Black Duck, White-faced Heron, Nankeen Night Heron and the Royal Spoonbill. Other birds that have been observed at Mambo Wetland include Rainbow Lorikeet, Pheasant Coucal, Sacred Kingfisher, Dollarbird, Scarlet Honeyeater and many more.

8.4 Threatened Species

A number of threatened species have been recorded in Mambo Wetland which are listed in Table 1. Mambo Wetland provides suitable foraging and roosting habitat for these species, while adjacent areas such as Wanda Wetland provide additional habitat for more mobile species such as birds and bats.

Table 1: Threatened species recorded in Mambo Wetland.

Scientific Name	Common Name	Status
Ixobrychus flavicollis	Black Bittern	V
Phascogale tapoatafa	Brush-tailed Phascogale	V
Burhinus grallarius	Bush Stone Curlew	E
Miniopterus schreibersii	Common Bent-wing Bat	V
Vespadelus troughoni	Eastern Cave Bat	V
Mormopterus norfolkensis	Eastern Little Mastiff-bat	V
Calyptorhynchus lathami	Glossy Black-Cockatoo	V
Kerivoula papuensis	Golden-tipped Bat	V
Scotenax ruppellii	Greater Broad-nosed Bat	V
Litoria aurea	Green and Golden Bell Frog	E
Pteropus poliocephalus	Grey-headed Flying Fox	V
Phascolarctos cinereus	Koala	V
Chalinolobus dwyeri	Large Pied Bat	V
Myotis adversus	Large-footed Mouse-eared Bat	V
Miniopterus australis	Little Bent-wing Bat	V
Tyto novaehollandiae	Masked Owl	V
Pandion haliaetus	Osprey	V
Ninox strenua	Powerful Owl	V
Xanthomyza phrygia	Regent Honeyeater	V
Haematopus fuliginosus	Sooty Oystercatcher	V
Petaurus norfolcensis	Squirrel Glider	V
Neophema pulchella	Turquoise Parrot	V
Crinia tinnula	Wallum Froglet	V
Ptilinopus magnificus	Wompoo Fruit-dove	V
Litoria castanea	Yellow Spotted Tree Frog	V
Petaurus australis	Yellow-bellied Glider	V
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V

V = listed as vulnerable under the TSC Act 1995
E = listed as endangered under the TSC Act 1995

8.5 Community Koala Monitoring

One of the actions arising from the Port Stephens Council Comprehensive Koala Plan of Management (CKPoM) was to conduct an annual community koala monitoring program. The purpose of these surveys was to identify changes in koala numbers, locations and community perceptions of koala issues. The first community survey was conducted in 1992 prior to the development and implementation of the CKPoM.

The 2004 survey was the first community survey conducted since the implementation of the CKPoM. Survey forms and maps were mailed out to 28,600 households and businesses in the Port Stephens Local Government Area (LGA) in October 2004. The surveys questions were the same as those on the 1992 survey form, although the 2004 survey included an additional question relating to koala sightings specifically on Saturday 23 October 2004.

In Salamander Bay 16% of respondents reported seeing koalas on a monthly to quarterly basis, while 39% reported seeing koalas occasionally. Sitings in Corlette decreased slightly between 1992 and 2004, with 24% seeing koalas occasionally and 50% of respondents having never seen a koala. In Soldiers Point there was a slight increase in sitings between 1992 and 2004 with 35% of respondents in the 2004 survey reporting that they had seen koalas occasionally.

There was a consistent decrease in the proportion of respondents who have never seen a koala and an increase in the proportion of respondents who made lower frequency sightings across each age range between 1992 and 2004. There has been a decrease in the number of sitings of koalas with young and an increase in sitings of sick koalas. Less people had seen dead koalas, but those that had seen dead koalas had seen them dead on a road.

On the 23 October 2004, in the Salamander Bay area 36 individual sitings of koalas were made and 6 individual sitings of young koalas/cubs were made.

8.6 Koala Rescue Data

During the period of 2001 to 2005, 55 koalas from the Corlette and Salamander Bay area were taken into care following motor vehicle injury, bushfire, disease/sickness or dog attack. 43 of those 55 were released back into their natural habitat and 12 did not survive (Native Animal Trust Fund, 2005).

9.0 ABORIGINAL HERITAGE

9.1 Cultural significance of Mambo Wetland

The environment of Mambo Wetland was utilised by the Maaiangal people, a clan of the Worimi tribe. Two large shell middens as well as other scattered smaller middens throughout Mambo Wetland provide evidence of Aboriginal occupation in the area. Discussions with representatives from the Maaiangal Heritage Group also suggest that there may be burial sites within the reserve as well as artefacts and stone implements.

It is considered that the wetland was utilised strongly by the Maaiangal people since it provided a good source of food such as fish, insects, native seeds, roots and berries. Other fauna was also used for food and clothing resources. Many plants were used for medicines, dyes and weaving.

Some plants, animals and birds are also significant as spiritual totems. Specific species have significance as kinship and tribal totems, birth totems and sex totems for women and men.

A sacred women's site is present in Wanda Wetland, adjacent to Mambo Wetland. The women's area was used for birthing and initiations and the waterhole is considered sacred to the Maiaangal people. Wanda Wetland is also the site of a massacre so this brings added cultural significance. Prior to development it is likely that many of the wetlands in the area, including Mambo and Wanda Wetlands, were interconnected and areas now developed were once wetlands as well. As such, the wetlands were used similarly by the Maiaangal people and thus the cultural links between the wetlands are strong.

The intrinsic natural values of the wetland, the strong cultural links between Mambo Wetland and the wetland systems as a whole in the Salamander Bay area, as well as specific artefacts, implements and sites, are what make Mambo Wetland significant for the Maaiangal people. For these reasons, the conservation of Mambo Wetland and its natural and cultural features are highly important to the local Aboriginal people.

This parcel of land is currently categorised as a Natural Area within the Port Stephens Council Generic Natural Areas Plan of Management 2003. Throughout the community consultation process for the Mambo Wetland Plan of Management, significant cultural heritage issues for the Maaiangal people were identified. As a result it is the intention of this Plan of Management (PoM) to re-categorise this community land as 'Culturally Significant' under Section 36 (3) (a) of the Local Government Act 1993. The classification of community land is discussed further in Section 14.0.

This PoM is to provide a management tool to protect the current and future integrity of the cultural heritage of Mambo Wetland. Any proposed changes to land use must therefore be in consultation with the Maaiangal people.

All of the issues identified in Section B of the PoM impact on the cultural heritage values of the site. As such, by carefully managing these issues and maintaining a cultural awareness within the community, the cultural significance of Mambo Wetland can be protected,

9.2 Broader Cultural Heritage Projects

The Aboriginal Cultural Landscape Planning project is part of the Comprehensive Coastal Assessment Program and encompasses coastal areas in the Hunter Central Rivers catchment including Port Stephens. The Department of Infrastructure, Planning and Natural Resources is undertaking the project to assess Aboriginal cultural community values within coastal zones (pers. comm. Mick Leon, DIPNR). The project will ultimately provide Council with resources about the cultural significance of land so that more informed planning decisions can be made in consultation with Aboriginal communities and other relevant organisations.

There is no formal recognition of the cultural significance of Mambo Wetlands by the Department of Environment and Conservation – National Parks and Wildlife Service (NPWS) and no mapping has been undertaken at this stage. Discussions with NPWS indicate it is likely that specific Aboriginal cultural heritage information will be recorded in the near future.

It is important that Council be actively involved in these projects so that the cultural heritage values of Mambo Wetlands are conserved for future generations.

10.0 CATCHMENT DRAINAGE AND URBAN STORMWATER

Mambo Wetland receives water from a catchment area of 860 hectares. Rainfall in this catchment flows through natural creek lines, artificial wetlands, infiltration ponds and constructed drainage lines, until it reaches the wetland. The wetland filters nutrients and sediment from the water it receives, and then releases it slowly into Salamander Bay through Mambo Creek.

Over the past 20 years there has been a rapid increase in urban development in this catchment. The consequence of this is an increase in pollutants, including nutrients and sediment, entering the wetland leading to decreased water quality and greater weed infestation. Additionally, as a result of an increase in hard, non-permeable surfaces there is an increased volume and velocity of runoff impacting on Mambo Wetland.

Little is known about the precise effects of urbanisation on the ecology of Mambo Wetland and its capacity to cope with increased discharges, but in general the results are detrimental. Increased nutrients in the wetland have encouraged the growth of weed species and sediments are likely to have changed plant communities and possibly fauna assemblages to a certain, but currently unknown, extent.

There have been incidents of flooding of several properties along Foreshore Drive, which had not been previously affected. It was thought that culverts connecting Mambo Wetland and Salamander Bay were restricting flow resulting in flooding during peak flow times. A hydrological study has been undertaken into these flooding occurrences and it has been found that the culverts are not likely to be the cause of flooding.

The actual cause of flooding was determined to be due to a contraction in one of the main channels that flows to the main storage area of the wetland, flowing in front of the affected properties. This contraction along with growth of vegetation causes the channel to act as a basin, with the small section of the channel acting as the outlet.

The study also looked into the increased influx of pollutants from urban areas and their impact on water quality. Due to the short time period over which water samples were taken, the results were deemed to be inconclusive and further monitoring of water quality is still required. Modelling was carried out to gain a longer term insight of water quality, however, as the model could not be calibrated, the results were also inconclusive.

11.0 FIRE HISTORY

Mambo Wetland and surrounding areas have had a history of frequent fires. These have been natural wildfires as well as accidental and deliberately lit fires. It has been suggested that this high frequency of fires has altered the original vegetation communities. Fire tolerant plant species have become prevalent over those species which are less able to cope with the effects of such a fire regime (Econetwork, 1993).

The most recent fire at Mambo Wetland occurred on 1 January, 2003. This fire was accidentally ignited by a signal flare, which burnt over an area of around 100 hectares. The fire resulted in the loss of a significant proportion of the understorey vegetation; however the impact on canopy species was less severe. Seven injured Koalas were rescued by the Native Animal Trust Fund, which have subsequently been released back into the reserve. The environment appears to be regenerating well after the fire. Coloniser species such as Bracken Fern (*Pteridium esculentum*) and Blady Grass (*Imperata cylindrica*) have appeared first, followed by a number of herbaceous and shrub species, including leguminous *Acacia* species, *Bossiaea* sp. and other members of the Fabaceae family.

The Port Stephens Bushfire Hazard Management Plan rates Mambo Wetland as a moderate risk. The risk class specifies '*Unlikely loss of life or major injuries – medical treatment may be required. Property damage localised – short term external assistance required. Long-term landscape damage.*'

Despite the moist nature of Mambo Wetland there is still the potential for fire to occur, and therefore adequate measures must be undertaken to protect life and property, as well as the ecological values of the wetland.

12.0 REGIONAL CONTEXT

Mambo Wetland is a significant natural area. It is part of the Port Stephens Estuary, which was listed under the Register of the National Estate in 1998. The Estuary gained this listing as a result of its ecological significance. The Port Stephens Estuary contains the largest area of mangroves and the second most extensive area of seagrass in New South Wales, as well as a significant area of saltmarsh. These communities are in a good condition and are prime examples of these vegetation types in northern New South Wales. They are also important for maintaining regional fish, prawn and crab populations through the provided nursery habitats. The area is an important feeding and staging area of migratory waders, and is considered to be one of the six most important wader habitats of coastal New South Wales.

Kooragang Island Nature Reserve occurs approximately 45km to the south of Salamander Bay, and is the largest single estuary wetlands reserve in NSW, providing a magnet for migratory shorebirds from the northern hemisphere. It is considered that species, (particularly migratory birds), occurring in Kooragang Island Nature Reserve may utilise habitats in Mambo Wetland and vice versa.

MAMBO WETLANDS

PLAN OF MANAGEMENT

Section B – Management Plan

13.0 RATIONALE FOR PLAN OF MANAGEMENT

The preparation of this Plan of Management is required for a number of reasons, which are outlined below:

- Port Stephens Council, as managers of the land, require a strategic framework that will provide guidance and direction for both the current and future management of the site.
- To provide a mechanism for the community to participate in setting the management direction for the study area.
- To identify any current or potential issues and provide policy and strategy to manage these in the future.
- To satisfy the legislative requirements as outlined in the Local Government Act 1993 (as amended).
- To protect the cultural significance and ecological values of Mambo Wetland for present and future generations.

The strategies identified in this plan of management address issues that are seen as priority at the time the plan was developed. While the conservation focused management objectives for Mambo Wetland will not change, it is recognised that new issues in relation to the conservation of the wetland may arise after the adoption of this Plan. As such management strategies outlined in this Plan may need to be adjusted, as these new issues arise.

14.0 AIMS AND OBJECTIVES

Aim

The Plan of Management aims to address key issues threatening the cultural and ecological values of Mambo Wetland such that the integrity of this important system is both enhanced and maintained. It is anticipated that the Plan will facilitate the conservation of intrinsic natural values and attributes of the reserve and its cultural significance to the local Aboriginal people. It should also provide Council and community groups with a strategic concept for conservation works for the future management of the site.

Objectives

Under Section 36(3)(a) of the *Local Government Act 1993,* Mambo Wetland is currently categorised as 'Natural Area'. However, this plan recommends the recategorisation of this land as an area of 'Cultural Significance", in recognition of the cultural values of Mambo Wetland. Whilst the primary category for Mambo Wetland will be 'Cultural Significance', four other sub-categories also apply; these being 'Natural Area', 'Foreshore', 'Wetland' and 'Bushland'. The guidelines for determining these categorisations are listed in Appendix 5.

The *Local Government Act, 1993,* sets out a number of core objectives in relation to community land for each of these categories:

CULTURAL SIGNIFICANCE

The core objectives for management of community land categorised as <u>cultural significance</u> under Section 36H of the LGA are:

(1) The core objectives for management of community land categorised as an area of cultural significance to retain and enhance the cultural significance of the area (namely its Aboriginal, aesthetic, archaeological, historical, technical or research or social significance) for past, present and future generations by the active use of conservation methods.

(2) Those conservation methods may include any or all of the following methods:

(a) The continuous protective care and maintenance of the physical material of the land or of the context and setting of the area of cultural significance;
(b) The restoration of the land, that is, the returning of the existing physical material of the land to a known earlier state by removing accretions or by reassembling existing components without the introduction of new material;
(c) The reconstruction of the land, that is, the returning of the land as nearly as possible to a known earlier state;
(d) The adaptive reuse of the land, that is, the enhancement or reinforcement of the cultural significance of the land by the introduction of sympathetic alterations or additions to allow compatible uses (that is, uses that involve no changes to the cultural significance of the physical material of the area, or uses that involve changes that are substantially reversible or changes that require a minimum impact);
(e) The preservation of the land, that is, the maintenance of the physical material of the land in existing state and the retardation of deterioration of the land.

NATURAL AREA

The core objectives for management of community land categorised as <u>natural area</u> under Section 36E of the LGA are:

(a) To conserve biodiversity and maintain ecosystem function in respect of the land, or the feature or habitat in respect of which the land is categorised as a natural area;
(b) To maintain the land, or that feature or habitat, in its natural state and setting;,
(c) To provide for the restoration and regeneration of land;
(d) To provide for community use of and access to the land in such a manner as will minimise and mitigate any disturbance caused by human intrusion;
(e) To assist in and facilitate the implementation of any provisions restricting the use and management of the land that are set out in a recovery plan or threat abatement plan prepared under the Threatened Species Conservation Act (1995) or the Fisheries Management Act (1994).

FORESHORE

The core objectives for community land categorised as <u>foreshore</u> under Section 36N of the LGA are:

(a) To maintain the foreshore as a transition area between the aquatic and the terrestrial environment, and to protect and enhance all functions associated with the foreshore's role as a transition area;
(b) To facilitate the ecologically sustainable use of the foreshore, and to mitigate impact on the foreshore by community use.

BUSHLAND

The core objectives for management of community land categorised as <u>bushland</u> under Section 36J of the LGA are:

(a) To ensure the ongoing ecological viability of the land by protecting the ecological biodiversity and habitat values of the land, the flora and fauna (including invertebrates, fungi and micro-organisms) of the land and other ecological values of the land;
(b) To protect the aesthetic, heritage, recreational, educational and scientific values of the land;
(c) To promote the management of the land in a manner that protects and enhances the values and quality of the land and facilitates public enjoyment of the land, and to implement measures directed to minimising or mitigating any disturbance caused by human intrusion;
(d) To restore degraded bushland;
(e) To protect existing landforms such as natural drainage lines, watercourses and foreshores;
(f) To retain bushland in parcels of a size and configuration that will enable the existing plant and animal communities to survive in the long term;
(g) To protect bushland as a natural stabiliser of the soil surface.

The core objectives of the management of community land categorised as <u>wetland</u> under Section 36k of the LGA are:

(a) To protect the biodiversity and ecological values of wetlands, with particular reference to their hydrological environment (including water quality and water flow), and to the flora, fauna and habitat values of the wetlands;
(b) To restore and regenerate degraded wetlands;
(c) To facilitate community education in relation to wetlands, and the community use of wetlands, without compromising the ecological values of wetlands.

15.0 DEVELOPMENT OF PLAN OF MANAGEMENT

15.1 Steering Committee

A Mambo Wetland Steering Committee was set up to direct the development of the Plan, as well as to oversee its implementation on completion. A number of representatives from a variety of backgrounds sit on the Committee and provide valuable input to the identification and management of issues associated with Mambo Wetland. Table 2 lists the organisations involved in the Mambo Wetland Steering Committee.

Steering committee meetings were held each six weeks during the development of the management plan. In these meetings, issues relating to Mambo Wetland were raised and discussed. All attempts have been made in this management plan to represent the issues raised in these meetings.

Table 2: Mambo Wetland Steering Committee Members.

Organisation/Position
Environmental Projects Officer, Port Stephens Council
Stormwater Officer, Port Stephens Council
Community Environment Officer, Port Stephens Council
Recreation Planner, Port Stephens Council
Drainage Engineer, Port Stephens Council
Parks Coordinator (East), Port Stephens Council
East Ward Councillor, Port Stephens Council
Senior Weeds and Pest Management Officer, Port Stephens Council
Fire Control Officer, Rural Fire Service
Maaiangal Heritage Group
National Parks and Wildlife Service
Native Animal Trust Fund (2 representatives)
Mambo/Wanda Wetlands Committee (5 representatives)

15.2 Public Meeting

A public meeting to discuss issues relating to the management of Mambo Wetland was held on the 16 June 2003, attracting over 60 representatives of the local community.

The public meeting provided the opportunity for the community to input into the direction of the future management of Mambo Wetland. The meeting also provided Council with a representation of the community's perspective of the issues to be addressed in relation to Mambo Wetland.

Minutes from the meeting were distributed to all attendees, and the items addressed have been considered in the development of this Plan. The list of attendees to this meeting is included in Appendix 3, along with the minutes that were recorded.

15.3 Literature Review

A review of the available literature on wetland issues and their management has been undertaken in the development of this Plan. Literature reviewed included management plans, journals, newspaper articles, conference papers, newsletters and pamphlets. A full list of references cited is included at the end of this document.

15.4 Community Consultation

Council has ensured that the community has been provided adequate opportunity for involvement in the development of the Mambo Wetland Plan of Management. Community participation has been facilitated through a public meeting, community representatives on the Mambo Wetland Steering Committee, community participation in flora and fauna surveys and public exhibition of the Draft Plan of Management. All input and feedback from the community has been taken into consideration and addressed in the plan of management where appropriate. A copy of the minutes of the public meeting has been included in Appendix 3. Members of the Local Aboriginal Land Council and the Maaiangal Heritage Group were involved in the preparation of the Plan and during the exhibition phase for the Draft Plan. The requirements for consultation concerning land categorised as an area of cultural significance is outlined in Schedule 1, Division 2 (6JB) of the Local Government Act Amendments, 1998. These are as follows:

(1) A council that is considering whether or not land is an area of Aboriginal significance must give notice of that consideration to Aboriginal people traditionally associated with the area in which the land is situated.

(2) That notice must be given by:

(a) written notice to the Local Aboriginal Land Council for the area concerned, and

(b) advertisement in a newspaper circulated across the State that is primarily concerned with issues of interest to Aboriginal people, and

(c) written notice on the land in a position where the notice is visible to any person on adjacent public land.

(3) The notice must:

(a) state that submissions may be made to the council, in relation to the council's consideration by any Aboriginal person traditionally associated with the area in which the community land is situated, and

(b) specify a period of not less than 28 days after the date on which the notice is given during which submissions may be made to the council.

(4) A council that is considering whether or not land is an area of Aboriginal significance (within the meaning of clause 6E (a)) must not make a final determination on that matter unless the council has considered any submissions made under this clause by Aboriginal people traditionally associated with the area in which the community land is situated.

(5) A council must not prepare a draft plan of management that categorises community land as an area of cultural significance on the ground that the land is an area of Aboriginal significance (within the meaning of clause 6 E(a)) unless the council has called for and considered any submissions made under this clause by Aboriginal people traditionally associated with the area in which the community land is situated.

15.5 Local Government Act Requirements

The *Local Government Act 1993* (as amended) provides the minimum requirements for public consultation for the preparation of PoMs. The parcels of land subject to this PoM are affected by the LGA, and Councils' approach to consultation during this process will be in line with these requirements.

The processes undertaken in the development of the Mambo Wetland Plan of Management are summarised as follows:

- Establishment of the Mambo Wetland Steering Committee.
- Public meeting held to identify and discuss various issues related to Mambo Wetland.
- Draft plan of management developed.
- Draft plan sent to steering committee and all relevant stakeholders for comment.
- Review and amend draft plan of management taking into account feedback provided by stakeholders
- Report to Port Stephens Council for approval to place Draft Plan of Management on public exhibition.
- Draft Plan of Management placed on public exhibition for a period of forty two (42) days which includes actual display period of twenty eight (28) days (as specified under Section 38 of the LGA). (As this Plan refers to land classified as an area of cultural significance, additional consultation requirements are necessary under Section 1 (6)(J)(A) of the LGA Amendments, 1998. These requirements are outlined in Section 15.4).
- Public Hearing held in relation to the changed land categorisation of Mambo Wetland with subsequent comments to be incorporated in the report.
- Comments provided through exhibition period collated and necessary amendments made to the Draft Plan of Management.
- Report to Port Stephens Council for the adoption of the Plan of Management or if any amendments back on exhibition (as required by the Local Government Act).

Port Stephens Council (2003)

The specific requirements for a Plan of Management as listed under the *Local Government Act, 1993,* are included in Appendix 6.

16.0 LINKS TO RELATED DOCUMENTS

There are a number of documents already prepared that link with the Mambo Wetland PoM. It is important that these links are recognised, such that the objectives of this management plan fits in with the relevant objectives contained in existing documents. The following is an overview of the documents relevant to this plan, and how they may assist with the formulation of management strategies under this PoM.

Bitou Bush Management Plan

The Bitou Bush Management Plan for Port Stephens Council is relevant due to the presence of infestations in Mambo Wetland. The plan provides a map of the weed infestation and outlines strategies that can be used to direct the control of this noxious weed within the reserve.

Comprehensive Koala Plan of Management (CKPoM)

The Comprehensive Koala Plan of Management (2002), prepared by Port Stephens Council with the Australian Koala Foundation, documents information on the ecology and habitat of these animals within the Local Government Area. The document includes comprehensive mapping of koala habitat, which provides important information on the koala population occurring in Mambo Wetland. The CKPoM also provides important information on wildlife corridors linking adjoining habitats.

The information contained within the CKPoM is an important resource that has been utilised in this plan for the development of management strategies for the conservation of koala populations and habitat within Mambo Wetland.

Natural Areas Generic Plan of Management

The Natural Areas Generic Plan of Management is the primary planning document for the management of community land categorised as a Natural Area within Port Stephens.

Port Stephens Council Urban Stormwater & Rural Water Quality Management Plan

The Port Stephens Council Urban Stormwater & Rural Water Quality Management Plan identifies the effects of urbanisation on the stormwater runoff within the local government area. This includes impacts on water quality as well as hydrology, erosion and sedimentation. The document has assisted with identifying specific stormwater issues for Salamander Bay and Mambo Wetland.

Local Government Act (1993)

The Local Government Act (1993) as amended provides a framework for the management and categorisation of Council owned Community Land. Relevant criteria within the Act sets out guidelines for the preparation of Plans of Management for community land including core objectives for each category as well community consultation requirements.

Draft Bush Fire Risk Management Plan (2003)

The Draft Bush Fire Risk Management Plan (BFRMP) (2003) has been prepared by Port Stephens Bush Fire Management Committee in accordance with the *Rural Fires Act, 1997*. The plan identifies the level of bush fire risk across the Port Stephens LGA and establishes strategies that the responsible land managers will implement to manage the bush fire risks identified.

The bush fire risk for Mambo Wetland described in the BFRMP has been considered in the development of fire management strategies for this Plan of Management.

17.0 LINKS TO RELEVANT LEGISLATION

There are several planning instruments and policies that may be relevant to the management of Mambo Wetland, which need to be considered in the Plan of Management. The relevant legislation that has been identified include:

- *Local Government Act (1993)*
- *Local Government Amendment (Community Land Management) Act (1998)*
- *Port Stephens Local Environment Plan (2000)*
- *Companion Animals Act (1999)*
- *Protection of the Environment Operations Act (1997)*
- *Regional Erosion and Sediment Control Policy and Code of Practice*
- *State Environmental Planning Policy (SEPP) No. 14 – Coastal Wetlands*
- *SEPP No. 44 – Koala Habitat Protection*
- *Native Vegetation Conservation Act (1997)*
- *Threatened Species Conservation Act (1995)*
- *Rivers and Foreshores Improvement Act (1948)*
- *Rural Fires Act (1997)*
- *Environment Protection and Biodiversity Conservation Act (1999)*
- *Fisheries Management Act (1994)*
- *Environmental Planning and Assessment Act (1979)*
- *National Parks and Wildlife Service Act (1974)*

- Agreement between the Government of Australia and Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA) 1974
- Agreement between the Government of Australia and the People's Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) 1986.

18.0 Key Threatening Processes

The National Parks and Wildlife Service has developed a list of processes that are considered to be key threatening processes. A key threatening process is defined in the *Threatened Species Conservation Act, 1995*, as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities. Something can be a threatening process if it:

- adversely affects two or more threatened species, populations or ecological communities; or
- could cause species, populations or ecological communities that are not currently threatened to become threatened.

There are four key threatening processes that are considered relevant to Mambo Wetland:

1. Competition and grazing by the Feral European Rabbit
2. Invasion of native plant communities by Bitou Bush and Boneseed
3. Predation by Feral Cats
4. Predation by the Plague Minnow (Mosquito Fish) – *Gambusia holbrooki*

The final determination made by the scientific committee for each of these key threatening processes is included in Appendix 4.

19.0 MANAGEMENT ISSUES

19.1 Introduced Flora

The impact of introduced flora is one of the most significant threats to the natural health of the Mambo Wetland ecosystem. Several species have invaded the wetland in both terrestrial and aquatic habitats. A map showing the weed species present in the wetland and the density of infestations is shown in Figures 12a and 12b. Weed Management Zones are shown in Figure 13.

19.1.1 Terrestrial Weeds

Issue

The dominant terrestrial weeds at Mambo Wetland include Bitou Bush (*Chrysanthemoides monilifera*) and Lantana (*Lantana camara*). The prolific dispersal mechanisms of these weeds allows them to quickly invade areas of native vegetation, in some cases resulting in a monoculture. Over a number of years, the dedicated work of volunteers carrying out bush regeneration has greatly reduced the distribution of these weeds within the reserve.

There are numerous other terrestrial weed species in Mambo Wetland, many of which have escaped from residential gardens. Common garden escapees in the wetland include Impatiens, Lipstick Hibiscus *(Malvaviscus penduliflorus),* Buffalo Grass *(Stenotaphrum secundatum),* Kikuyu *(Pennisetum clandestinum),* and Tibouchina *(Tibouchina granulosa).* The management of these smaller weed infestations depends upon identifying the infestation early, before the problem becomes unmanageable. Weeds such as Bitou Bush, Lantana and Camphor Laurel (*Cinnamomum camphora*) have been introduced to the wetland through dispersal of seed by birds.

Management Options

The Mambo/Wanda Wetlands and Landcare 355(b) Committee are actively involved in the management of weeds within the reserve. The efforts of these volunteers since the establishment of the group has seen a significant reduction in the weeds present at Mambo Wetland, in particular Bitou Bush and Lantana. The methods utilised by these volunteers include manual removal, 'cut and paint' as well as spraying. These methods have previously been proven successful and will continue to be used. Follow up weed control by this volunteer group is expected to continue and will contribute significantly to the future management of weeds.

In the management of Bitou Bush, control should be undertaken in accordance with the Bitou Bush Management Plan (PSC, 2003). The general principles and strategies outlined in this plan may be transferable to the management of other weeds.

In addition to the work of volunteers, it is recommended that Council undertake bush regeneration works to implement weed control strategies at times of the year that are the most beneficial for the particular weed being managed.

The management of garden escapees should involve two strategies. The first is to remove any infestations of new weeds before they become too difficult to manage. The second stage involves the education of residents adjacent to the wetland reserve. The issue of garden escapees and their impacts on the wetland environment should be brought to the attention of residents within the Mambo Wetland catchment. This education should advise of those species that are easily spread into the reserve, as well as emphasise the range of native species available that are an alternative to exotic species traditionally planted in gardens.

Figure 12a - Mambo Wetland - Terrestrial Weeds

N
W E
S
ISG 56/1

- Freesia
- Ludwigia peruviana
- Acacia saligna
- Planted Exotics/Garden Escapes
- Bitou Bush
- Lantana camara
- Bitou Bush + Acacia saligna
- Coral Tree, Acacia saligna, Lantana, Bitou Bush, Mother of Millions
- Perennial weeds along track edges
- Cycleways
- Drainage Lines

WEED DENSITY
1 = ABSENT
2 = LIGHT
3 = MEDIUM
4 = HEAVY

SCALE
0 metres 400

DISCLAIMER

Port Stephens Council accepts no responsibility for any errors, omissions or inaccuracies whatsoever contained within or arising from this map. Verification of the information shown should be obtained from an appropriately qualified person(s).

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SHEET LOCALITY

Figure 12b - Mambo Wetland - Aquatic Weeds

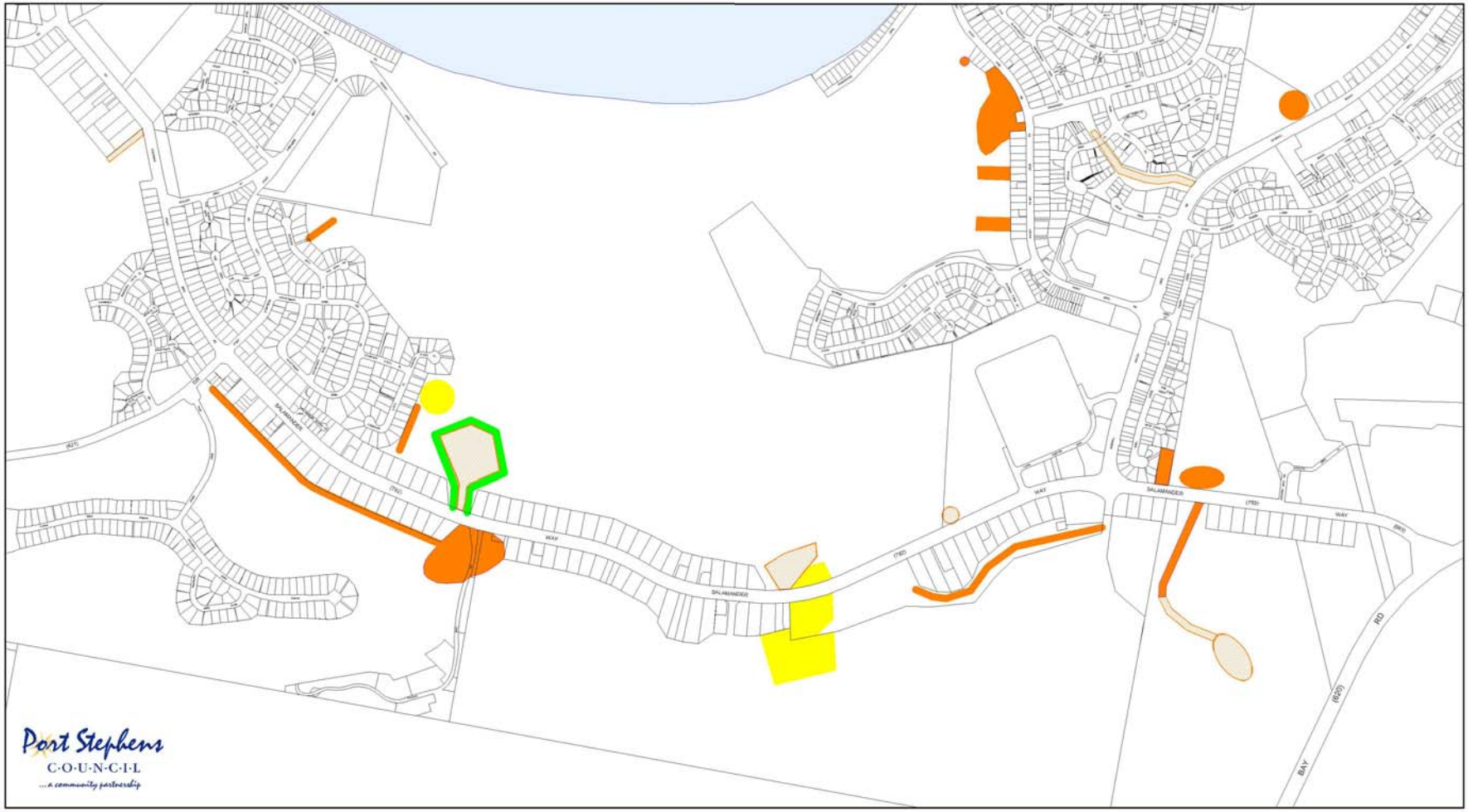

Figure 13 - Mambo Wetland - Weed Management Zones

N
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ISG 56/1

Low Priority
Medium Priority
High Priority
Cycleways
Drainage Lines

SCALE
0 metres 400

DISCLAIMER

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SHEET LOCALITY

19.1.2 Aquatic Weeds

Issue

Aquatic weeds refers to introduced plants growing within a body of water. The three major weeds that have invaded the waters of Mambo Wetland and tributaries feeding into the wetland are Salvinia (*Salvinia molesta*), Alligator Weed (*Alternanthera philoxeroides*), and Long-leaf Primrose Willow (*Ludwigia longifolia*). These species are able to spread by vegetative propagation and therefore can take over areas very rapidly once established. Aquatic weeds often occur where there are elevated levels of nutrients and sediment.

Salvinia and Alligator Weed tend to grow prolifically, covering the surface of water bodies. This mass on the water surface prevents light from penetrating the water and therefore threatens aquatic organisms dependant on this sunlight for survival. There is considerable biomass associated with these weed infestations, the breakdown of which takes oxygen out of the system, also affecting aquatic organisms.

Figure 14: Alligator Weed, *Alternanthera philoxeroides*

Figure 15: Salvinia, *Salvinia molesta*

Figure 16: Long-leaf Primrose Willow, *Ludwigia longifolia*

Ludwigia has the ability to invade both disturbed and near pristine wetlands. The massive numbers of seedlings, effective seed dispersal and ability of this plant to colonise wetland habitats present a significant management challenge.

Management Options

Aquatic weeds are very difficult to manage due to their ability to reproduce by vegetative propagation. Manual removal is one of the few options available for management of these weeds. In order to successfully achieve complete eradication, it would be necessary that every piece of the plant be taken away and removed offsite. This is near impossible and long-term follow-up is required to achieve eradication by hand removal techniques.

Alternatives to manual removal include the use of herbicides and biological control. Herbicide use within water bodies is often not suitable, as this can pollute the waterways and the organisms it supports. Biological control can be effective; however it is not likely to result in the complete eradication of a weed. Biological control is often used to control an outbreak, such that it can be managed more effectively with other techniques such as manual removal and use of herbicides.

Port Stephens Council Weed Officers shall also contribute to the management of weeds within Mambo Wetland. Their responsibility will primarily involve herbicide spraying of larger terrestrial weed infestations and of aquatic weeds. The weeds officers should also continue to trial the adoption of new weed management techniques as they become available.

A project completed in 2004, investigated the incursion of *Ludwigia longifolia* in Mambo Wetland. The project concluded that immediate action is essential in the control of this weed. The report has provided baseline information to Council for the development of a specific management strategy for Ludwigia. A monitoring program is also necessary to assess the level of success of any control program implemented.

A grant from the Commonwealth NHT Envirofund will help manage this serious weed threat. The project will seek to remove the majority of the mature flowering plants, greatly reducing the amount of seed dropped; to spot-spray and remove emerging seedlings; and revegetate areas using native plants to shade out the next generation of seedlings. These sites have been sign-posted and will be monitored bi-annually with adequate resources deployed to curb the spread of this highly invasive weed.

As aquatic weeds are linked to elevated levels of nutrients and sediment, control of stormwater pollution can assist in their management. Refer to Section 18.5 for stormwater management recommendations.

19.2 Feral Animals and Domestic Pets

Issue

A number of feral animals have been introduced to Mambo Wetland where they are now competing with the native fauna species present. Table 3 lists the introduced fauna in Mambo Wetland and summarises the impact of these on the natural environment.

Table 3: Introduced fauna species of Mambo Wetland and their impacts.

Introduced Fauna Species	Threats to Native Fauna
Foxes	Large predator feeding on possums, gliders, marsupials, birds etc.
Rabbits	Graze heavily on native vegetation when occurring in large numbers. Competition for resources with native fauna.
Mosquito Fish or Plague Minnow (*Gambusia holbrooki*)	Disturb sediment in water bodies which increases turbidity which is detrimental to other aquatic organisms. Implications for small native fish. Predator of native tadpoles (including the threatened *Crinia tinula*), threatening frog populations.
Domestic Ducks and Mallards	These exotic ducks occur in large numbers and compete with native ducks. Their faeces add excess phosphorus to the waterways. Mallard may interbreed with native Black Ducks creating hybrid species.
Indian Mynas	Compete with native bird species for nesting hollows. Their dominant nature deters other bird species from roosting sites.
Exotic Bees	Compete for tree hollows with other hollow dependant fauna. Displaces the role of native bees in pollen dispersal and competes with native bees for food resources.

Domestic pets are also recognised as a serious threat to the native fauna occurring within Mambo Wetland. Although Mambo Wetland is deemed a dog-free area, some local residents frequently take dogs (both on and off leashes) through the reserve.

A number of instances of dogs attacking native fauna have been recorded, with particularly vulnerable species including Koalas, possums, gliders and native rats. Even if there is no attack or the attack itself is not fatal, some animals may suffer greatly from the stress of the encounter with these large predators. Dogs are also known to attack reptiles including lizards and snakes.

Cats are also a threat to native fauna, particularly bird and lizard species, due to their hunting instincts. Cats are accomplished hunters by nature and are successful on more occasions than many owners are aware. It is difficult to control the predation of native birds and lizards by cats, as they are generally allowed to roam freely.

Management Options

Strategies for the management of feral animals shall be developed in co-ordination with the National Parks and Wildlife Service, the Port Stephens Vertebrate Pest Management Committee and Port Stephens Council Weed and Pest Officers. Surveys may need to be undertaken to determine the population size and preferred habitat of feral animals such as rabbits and foxes. The results of these surveys may then be used to develop a control strategy should this be deemed necessary.

Indian Mynas are not a problem that can be solely addressed within the Mambo Wetland catchment and thus cannot be dealt with directly as part of this Plan of Management. It is recommended that a

local government-wide management strategy for the control of Indian Mynas be developed, before the population increases significantly such that the problem becomes unmanageable.

Land managers across Australia have developed a number of strategies for the management of the Mosquito Fish (*Gambusia holbrooki*), however there have been few documented cases of successful eradication. Based on the literature into the management of this pest species, the impacts of control are often far greater than those of the fish itself. Some strategies include the draining of the wetland, application of chemicals that may be toxic to other aquatic organisms, or introduction of biological controls which may be greater predators of native species than the Mosquito Fish itself. According to the NPWS (2003), the only effective control methods kill all fish species present and other native fauna as well as *Gambusia*. In light of this, active management strategies for *Gambusia* will only be undertaken if research shows that the population is significantly threatening the health of the wetland and its ecological components. If necessary, it may be feasible to create a *Gambusia* free area within the wetland in which native species threatened by this pest can be protected.

Control of domestic animals and their impact on native fauna will be managed through environmental education initiatives. The community, particularly those residents adjacent to Mambo Wetland, should be made aware of the impacts that their pets have on native fauna. Education should provide simple information on responsible pet ownership such as utilising dog leash free areas and on-leash areas and keeping cats inside at night.

Increased emphasis on enforcement of the legislation should be considered. This may include increased Ranger visitation to the area and the installation of interpretive signage in strategic locations. It is recommended that a review of the current standard signs for prohibition of cats and dogs in reserves be undertaken. More effective alternatives should be considered, that are specific to Mambo Wetland. The important values of the wetland and how dogs and cats threaten these values should be emphasised on these signs.

There are few options available for the ethical removal of domestic ducks, but it may be possible to relocate domestic species to a more suitable situation. Feeding of ducks in and around Mambo wetland, particularly in Sandpiper Reserve, should be discouraged. Feeding promotes congregation of the ducks and subsequent nutrient enrichment of waters from faecal matter. As Mallards are 'wild' ducks which do not live in the wetland, management would be difficult and further research into the population utilising Mambo Wetland should be undertaken before any other control program is developed. This should be carried out in conjunction with the National Parks and Wildlife Service.

19.3 Encroachment of Development

Issue

In recent years, there has been a significant increase in urban, commercial and industrial development at Salamander Bay. The result is that large areas of natural bushland have been cleared, reducing the habitat for native flora and fauna species.

While some bushland areas have been conserved, these habitats are fragmented and greatly reduced in size. Many species require a large area in order to sustain a viable population that can forage and breed sustainably. A decrease in habitat size for these species may result in their local extinction in the long term.

Further development of bushland in Salamander Bay and surrounding areas will have a significant impact on the health and viability of Mambo Wetland. This is because parcels of bushland surrounding

the wetland are important for those flora and fauna species whose dispersal mechanisms allow them to travel between bushland fragments. Utilising surrounding habitats effectively increases their habitat size, and therefore potential for sustaining a viable population size.

Not only does the encroachment of development decrease habitat size, it also impacts on the health of the environment through what are referred to as 'edge effects'. Mambo Wetland is surrounded by urban development and is directly influenced by urban activities. Walkways/cycleways and bushfire hazard reduction zones also contribute to edge effects. Disturbances associated with edge effects include rubbish and garden waste dumping and increased susceptibility to weed invasion. Additionally, some native fauna species are timid and avoid utilising habitat in the edges of reserves, effectively reducing their habitat size further.

The future use of a parcel of land within the Mambo Wetland area, but not within the Reserve, owned by the NSW Department of Education is not clear. Any development on this land may have a negative impact on the wetland.

Management Options

It is recommended that Mambo Wetland be re-categorised as 'culturally significant' as discussed in Section 14.0 in addition to the 'natural area', 'wetland', 'foreshore' and 'bushland' categories under the *Local Government Act, 1993*.

In February 2003, Council passed a motion to support an application to declare Mambo Wetland a wildlife refuge. Additionally, a Voluntary Conservation Agreement (VCA) has been sought through the National Parks and Wildlife Service for the nearby Wanda Wetland, which is anticipated to provide long term conservation of this wetland. Options could also be investigated for dedicating the reserve though State Government. This may prove a greater level of protection for the wetland.

Clarification of the intended use of the NSW Department of Education land adjacent to the reserve should be sought. Ideally, inclusion of this parcel of land for the purpose of environment protection would be appropriate.

Actions undertaken to address the issue of edge effects should include education of adjoining residents of the impacts of garden refuse dumping, rubbish dumping and domestic dogs and cats. Residents should also be informed on suitable native species that are an alternative to exotic species in gardens that may spread into the nearby bushland.

In particular, education programmes undertaken must have a joint approach between Council and wildlife rescue organisations such as the Native Animal Trust Fund for best results.

Ranger patrols need to target dogs in the reserve and interpretive signage may be useful in education of dog-owners and the threat that dogs have on wildlife.

19.4 Wildlife Corridors

Issue

Clearing of land for development has lead to the fragmentation of bushland habitats. Prior to clearing, native fauna was able to move widely between different habitats in search of food and other resources. As a result of clearing and development, these wildlife corridors are divided by roads, houses and other infrastructure, impeding wildlife movements between habitats.

Management Options

An aerial photograph showing supplementary habitats in close proximity to Mambo Wetland is shown in Figure 17. This demonstrates there are a number of small bushland fragments, which are isolated by roads and urban development. It is recommended that studies be undertaken to identify important wildlife corridors and subsequently undertake measures to ensure safety of fauna moving between these areas.

While it is certainly not feasible to remove houses and roads to re-establish wildlife corridors, some measures can be undertaken to enhance remaining vegetation to enable fauna to move safely between fragments.

Plantings on private and public land will be carefully planned to provide the most effective corridors for wildlife while also protecting fauna including Koalas from dogs and motor vehicles. Care must be taken to ensure that Koala food trees are not planted in high risk locations such as a private yard with a dog.

In addition to street tree plantings, there are several areas within the Mambo Wetland reserve that require revegetation with suitable fauna habitat trees. Areas requiring supplementary plantings include the perimeter of the reserve; areas where weeding has been undertaken; and areas disturbed by previous sand mining. Section 20 outlines guidelines to assist in the planning of revegetation activities.

Figure 17 - Aerial Photo (Oct, 1998) showing Supplementary Fauna Habitat

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19.5 Urban Stormwater

Issue

Mambo Wetland is the central point to which all stormwater runoff from the surrounding catchment drains. The catchment feeding into Mambo Wetland is approximately 860 hectares. As the stormwater flows through the urbanised catchment it collects sediment, nutrients, litter and other contaminants along the way. This cocktail of pollutants ultimately ends up in Mambo Wetland where it can have detrimental impacts on aquatic organisms and/or processes. Urban stormwater can also lead to the alterations of the hydrology of the wetland, the impacts of which are discussed in Section 18.6.

Figure 18: Accumulation of litter in stormwater outlet entering Mambo Wetland.

Management Options

The ideal solution for the management of stormwater pollution is to control the problem at the source. It is advantageous to manage stormwater pollution in this manner, as it is often difficult and costly to control the pollutants once they have entered the system. The most widespread approach for source control of stormwater is the education of residents within the catchment. For the management of stormwater issues at Mambo Wetland, it is proposed that education material be provided to residents and business through the 'Mambo Jumbo' newsletter, the distribution of stormwater brochures specific to the wetland as well as continuation of local government wide stormwater education and provision of education and enforcement of erosion and sediment control requirements on building sites.

Further to the education of residents, it is considered essential that future developments within this catchment consider the principles of water sensitive urban design. Therefore, it is a recommendation of this plan that consent conditions for new developments should incorporate water sensitive urban design principles in Mambo Creek catchment. A recent subdivision at Worimi Drive has implemented a number of water sensitive urban design principles, including the

construction of stormwater retention ponds at strategic locations. The success of this subdivision should be used as a benchmark for future developments within the catchment.

It is recognised that a major source of nutrient runoff is the golf course adjacent to Mambo Wetland. In order to reduce the amount of nutrients entering the wetland, it is recommended that a cooperative relationship be developed with golf course management to reduce nutrients. Possible measures to be undertaken include education on alternatives to chemical fertilisers and more efficient nutrient assimilation structures within the golf course grounds.

Similarly, the Salamander Bay Shopping Centre is recognised as a significant source of litter and sediment contamination of the wetland. It is recommended that Council coordinate programs with the centre management in order to minimise litter and sediment contaminating the wetland.

The Port Stephens Urban Stormwater and Rural Water Quality Management Plan (2003) recommends that a processes study of Mambo Wetland be undertaken including an investigation into the possible conversion of a number of existing retention basins and swales into 'dry' infiltration basins within the Bagnalls Beach area in order to reduce runoff into the wetland. This processes study has been included in the project list for the potential extension of the environmental levy.

19.6 Alterations to Hydrology

Issue

Urban development has altered the natural hydrology of the catchment by decreasing infiltration and increasing runoff. Urban areas have a high proportion of impermeable surfaces, so very little water is infiltrated to the soil. There is a greater volume of surface water and thus a high velocity of flow. The majority of water enters the stormwater drainage system, which flows into Mambo Wetland. In contrast to this, natural catchments have permeable surfaces through which water infiltration can occur with flows naturally permeating slowly into the wetland. Wetlands are excellent in this manner for controlling flood waters and releasing them slowly into the environment.

Changes to hydrology in the wetland environment can affect soil development, sediment dynamics, plant growth and dispersal, aquatic animal access and many other processes (Zedler, 2001). High velocity water has more erosive force and can therefore lead to erosion and destabilisation of creek banks.

Mambo Wetland is characteristically a shallow water wetland, and the organisms that live there have adapted to this. Should the water levels change drastically due to this increased stormwater runoff, it may have negative impacts on the lifecycle of these species. For example, the Wallum Froglet (*Crinia tinula*) prefers shallow, slow running water to lay its eggs.

In addition to upper catchment changes in hydrology, the construction of Foreshore Drive has led to significant changes in the lower catchment. In order to construct the road, the natural outlet of the wetland into Salamander Bay was filled and replaced with concrete drainage pipes underneath the road. This has significantly reduced the flow of water out of the wetland into the bay, as well as impeding the natural tidal inundation of the estuarine mangroves (see Figure 19). Mangroves rely on saltwater tidal flushing, and since the construction of the road, mangrove health has declined. A recent hydrological study has shown that flooding of properties along Foreshore Drive has been incorrectly blamed on the restricted water flows under Foreshore Drive. In fact, the flooding was caused by a narrowing of a channel further up in the catchment which flows into Mambo Wetland.

Management Options

Many wetland processes are strongly dependant on hydrological factors, and alteration of these can be detrimental to the system as a whole. Management of the natural drainage catchment is essential to the successful management of the wetland (Department of Water Resources, 1990).

Similar to the management recommendations for urban stormwater pollution, controlling the problem at the source shall also be adopted for this issue. Again, this will involve an education program addressing the issues specific to Mambo Wetland, with the target audience being the local residents who are directly affecting the processes within this catchment.

Whilst it is difficult to manage urban stormwater in existing developments, there are increasing opportunities for improved stormwater management in new developments. The Port Stephens Council Urban Stormwater & Rural Water Quality Management Plan outlines a number of water sensitive urban design principles, which assist in increasing infiltration and reducing contaminated runoff. The implementation of these principles should be incorporated into development consent conditions for all future proposals within the catchment. Some of the water sensitive design principles to be considered include:

- Implementation of sediment control devices during construction phases
- Encouraging residents to install domestic rainwater tanks
- Installation of gross pollutant traps
- Purpose-designed stormwater retention basins
- Encouraging residents to vegetate yards to increase infiltration

In order to address the issue of impeded drainage out of the wetland, it has been recommended that a larger culvert be constructed underneath Foreshore Drive. This should allow more efficient drainage of the wetland. The flooding of houses on Foreshore Drive caused by an upstream channel narrowing needs to be further investigated before the problem can be adequately addressed. A larger culvert will improve tidal inundation of the mangroves, thus improving the health of that plant community.

Figure 19: Stormwater outlet at Mambo Creek during high volume flow.

19.7 Fire Management

Issue

There are a number of issues relating to fire management in Mambo Wetland. It is necessary to manage fire such that the ecological values of the wetland are conserved; however it is also important to protect people and property that may be affected by a fire in Mambo Wetland. The management of fire within the reserve must ensure that a balance between these values is achieved.

The frequency of fire in Mambo Wetland has increased as a result of accidental and deliberately lit fires. An example is the fire in January 2003, which was ignited by a signal flare. The majority of the vegetation types in Mambo Wetland are sensitive to high frequency fire. This means that fire should be excluded from this area where possible due to fire intolerant assets. Figure 20(b) is taken from the Draft Bushfire Risk Management Plan and demonstrates the risk assessment for the bushland in and surrounding Mambo Wetland. The final plan, to be adopted after the Mambo Wetland Plan of Management, may contain slight modifications.

Different studies recommend different fire regimes for the vegetation types occurring within Mambo Wetland: a fire frequency of 20-50 years is suggested by Hall and Saunders, 1998, while NPWS recommend a frequency of seven to ten years for Strategic Fire Advantage Zones (SFAZ). An increase in natural fire frequency results in the loss of fire sensitive species, which are replaced by fire tolerant species. This can lead to a significant change in the vegetation floristics and structure of the wetland vegetation, and a subsequent decline in biodiversity. Other negative impacts of fire on a wetland environment include increased erosion and sedimentation due to loss of vegetation cover, increased weed infestation due to disturbance and nutrients leaching from ash.

Management Options

In the event that a fire does ignite within the wetland, it is important that safe access for fire fighters is available such that they can effectively control the blaze. After thorough liaison with the Rural Fire Service, Mambo/Wanda Wetlands Committee and the Local Aboriginal Land Council, the fire trails through the reserve have been altered. The changes have provided turning areas for fire vehicles to ensure safe passage in and out of the reserve.

A range of strategies will be adopted for the management of fire in Mambo Wetland, including development and implementation of Asset Protection Zones (APZ) and Strategic Fire Advantage Zones (SFAZ) as well as community education. Figure 20(a) shows the areas in which each of these strategies will be adopted. This figure allocates numbers for different areas of the reserve in which fire management strategies will be undertaken. The proposed fire management actions for these areas are described below.

1. Existing Asset Protection Zones (APZ)

There are several areas in which existing infrastructure provide suitable Asset Protection Zones, and therefore these areas do not require additional management.

As shown on Figure 20a, the northern boundary of the wetland is protected by Foreshore Drive (1a), Port Stephens Drive buffers the north-west edge, the cycleway buffers the south west (1c) and behind Mariner Drive (1d), and Salamander Way (1b) also provides fire buffer protection.

Following a review of environmental factors APZs were implemented behind houses on Mariner Drive (2a) and behind the community centre in Salamander Bay (2b). The community centre is recognised as a high risk area due to the large number of people concentrated in the buildings at any point in time. The (2a) buffer zone is 20 metres, while (2b) is approximately 40 metres.

The maintenance of these APZs is a key to fire management. This includes keeping vegetation levels down and ensuring that the areas are clear of rubbish and stored materials from private property.

2. Strategic Fire Advantage Zones (SFAZ)

Six areas within the reserve have been designated for controlled burns, to be undertaken in a mosaic pattern. Initially, one of these areas will be burnt each year with a cool, low intensity fire. Subsequent fires in each of these patches will be implemented on a 7 – 10 year regime.

Implementing controlled burns will result in lowering the intensity of unplanned fires, which in turn will make fire easier to manage by reducing the danger of ember attack on human assets. In the long term, the mosaic fire regime should prevent the unplanned burning of the central part of the wetland reserve. In the event of a large unplanned wildfire the SFAZ should act as a refuge area, food resource and recolonisation base for fauna and flora. Furthermore, a SFAZ will provide refuge habitat for native fauna and protect fire sensitive vegetation from frequent burning regimes.

3. Community Education

Certain areas of the wetland are too wet to undertake hazard reduction activities such as APZs and SFAZs. In these areas it is recommended that residents should be educated on how they can actively manage their own property and assets to reduce bushfire hazard.

Some actions that residents adjacent to the wetland can adopt to increase property protection and safety include regular gutter cleaning, removal of debris from yards and the installation of rainwater tanks and pumps for the purpose of fire-fighting.

In relation to fire management, a continued cooperative approach between Council, Rural Fire Service, Mambo Wanda Wetlands 355B Committee and wildlife rescue organisations will best achieve well-planned fire management and habitat retention and monitoring.

Figure 20a - Bushfire Management Plan

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ISG 56/1

APZ PROPOSED ASSET PROTECTION ZONE
STRATEGIC FIRE ADVANTAGE ZONE
EXISTING ASSET PROTECTION ZONE
HAZARD REDUCTION (Difficult due to environmental constraints. Community education required)

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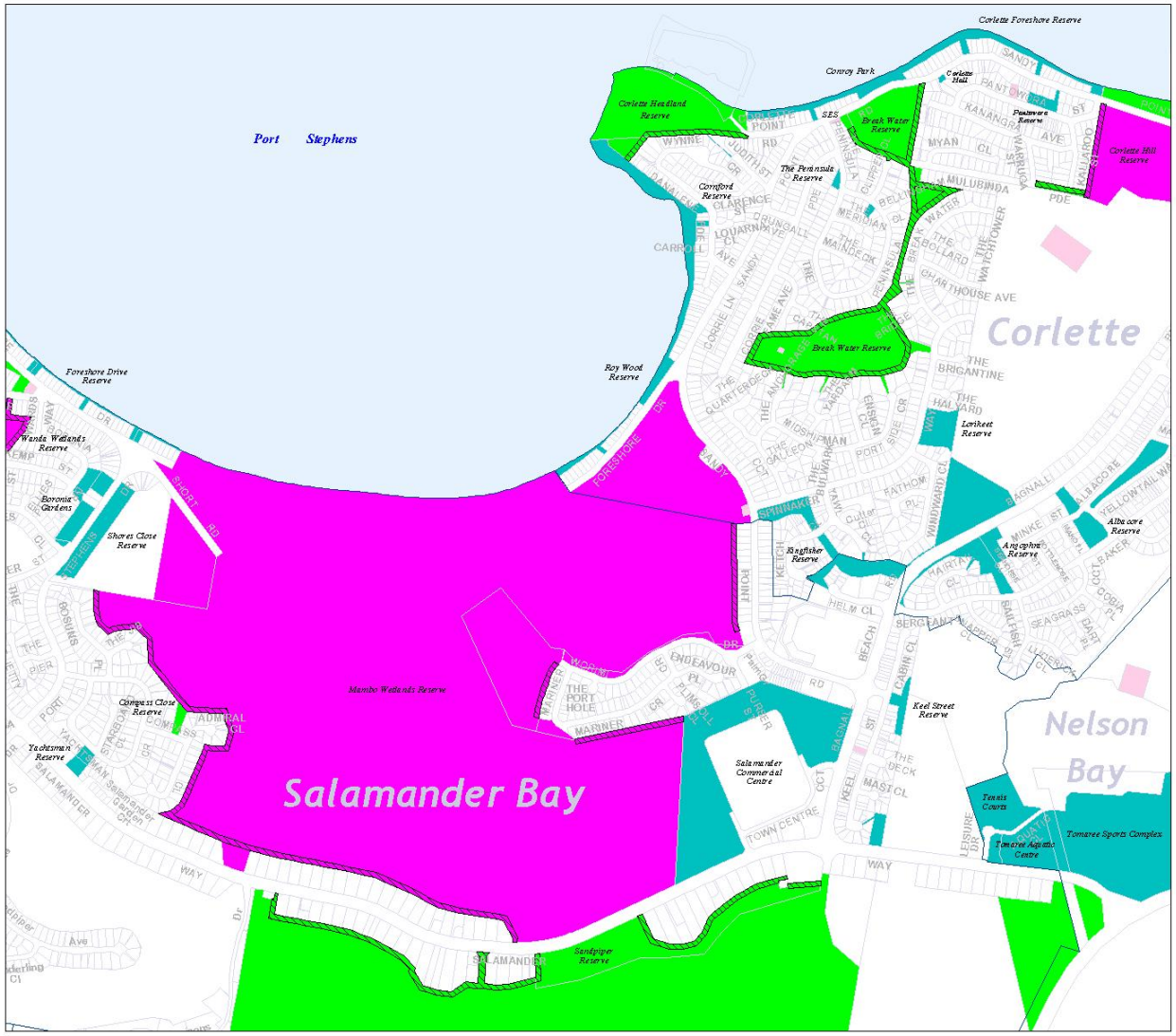
SHEET LOCALITY

Figure 20b: Bushfire Hazard Management Plan - Corlette/Salamander Bay



Bushfire Risk Classes

Extreme Risk	5	Fatalities and major injuries likely within populated areas. Native species extinction.
Major Risk	4	Fatalities less likely as attributes give some protection. Property loss extensive and widespread. Irreversible environmental damage.
Moderate Risk	3	Unlikely loss of life or major injuries - medical treatment may be required. Property damage localised - short term external assistance required. Long term landscape damage.
Minor Risk	2	Minor injuries - first aid treatment only. Short term damage to assets - external assistance not required. Short term, localised environmental damage.
Insignificant Risk	1	No injuries likely. Little or no property damage or community disruption. Minor environmental impact.

Asset Protection Zone

Land Tenure Legend

National Park or Nature Reserve
State Forest
Hunter Water Corporation Land

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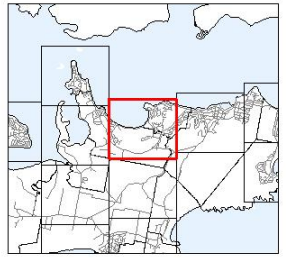

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19.8 Public Access

Issue

At present, the main point of public access through Mambo Wetland is from the northern end of Port Stephens Drive, where there is a series of walking tracks. These tracks are closed off from vehicular access, however are designated for fire-fighting vehicles in the event of fire. Despite access being restricted by gates, there have been observations of four-wheel drives and motorbikes entering the wetland. The illegal access of these vehicles causes the destruction of native vegetation, disturbance of fauna and their habitat, soil erosion and damage of the saltmarsh environment.

In addition to these walking tracks, a cycleway extends along the south to the south-east perimeter of Mambo Wetland. This cycleway is a concrete path, approximately 1.5m wide, providing access for bikes, prams and wheelchairs. The disturbance caused by this pathway reveals itself in the significantly larger density of weeds adjacent to the path. A number of weed species occur, including Cobbler's Pegs (*Bidens pilosa)*, Lantana *(Lantana camara)*, *Conyza sp.*, Fireweed *(Senecio madagascariensis)*, several annual weeds and exotic garden escapees.

Access to the foreshore for fishing, boating and other recreational activities is also a public access issue, however will be discussed separately in Section 19.9 below.

Figure 21: Vehicles entering the wetland cause degradation of the sensitive saltmarsh community.

Figure 22: Motorbikes illegally entering the reserve are one of the management issues at Mambo Wetland.

Management Options

In the interest of preserving the reserve in its near pristine condition there should be no further walking tracks constructed in Mambo Wetland, except for the completion of the walking track along Mariner Crescent, to attempt to avoid further disturbance and increase fire hazard. It is recognised that allowing public access gives rise to a range of issues such as weed invasion and rubbish dumping which compromise the ecological values of the wetland and as such, increasing access should be avoided.

Restriction of access by motorbikes and four-wheel drive vehicles to the wetland will be achieved by the construction of locked gates at all access points. Appropriate signs should be erected at these entrances in order to emphasise the reasons for restricted access (i.e. sensitivity of the environment) and the potential penalty for trespassing. Council Rangers should be made aware of these signs, and where possible, increased enforcement of restrictions.

It is recommended that current standard signage for prohibition of vehicle entry into reserves is reviewed. More effective alternatives should be considered, that are specific to Mambo Wetland. The important values of the wetland and how vehicles threaten these values should be emphasised on the signage.

19.9 Foreshore Erosion

Issue

Areas of the Salamander Bay foreshore where Mambo Wetland meets the sea have been subject to bank erosion. Boat launching in these areas has resulted in the loss and degradation of the vegetation along the foreshore, as well as destruction of mangrove and seagrass communities. As a consequence of the loss of foreshore vegetation, bank instability and erosion occur with tidal and wave action.. A further result is sedimentation of the bay and smothering of seagrass communities by sediment.

It is recognised that foreshore erosion may also be exacerbated by recreational fishing from the banks of the bay.

Management Options

In order to prevent access to the foreshore in degraded areas vehicle-proof gates will be installed at known access points. Signs should be placed on these gates describing the reasons for exclusion and the associated penalties for breaches. It is recommended that review of the current standard signage for prohibition of vehicle entry into reserves should be reviewed. More effective alternatives should be considered, that are specific to Mambo Wetland. The important values of the wetland and how vehicles threaten these values should be emphasised on the signage.

Once vehicle exclusion is successfully achieved, rehabilitation of degraded areas should commence. The removal of the disturbance may be sufficient to allow the vegetation to naturally regenerate, and this process should be regularly monitored. In the event that natural regeneration does not occur, assistance may be necessary in the form of native plantings and bank stabilisation measures. Where necessary, appropriate technical advice on foreshore stabilisation should be sought from relevant sources including the Port Stephens Estuary Management Committee

It is unknown to what degree recreational fishers are affecting the erosion of the foreshore, but with the exclusion of vehicles from the foreshore, it may be easier to determine this impact. Should it be revealed that recreational fishers are causing a significant degree of foreshore erosion appropriate measures may need to be undertaken to reduce the severity of this impact.

19.10 Mosquitoes

Issue

Some residential areas of Soldiers Point and Salamander Bay experience problems with mosquitoes during the summer breeding season. Aside from the irritating bite of mosquitoes, the major problem is their potential to carry disease. Surveys by Council have concluded that Mambo Wetland is not a major breeding area for mosquitoes. Mosquitoes breed in plague numbers in extensive saltmarsh areas such as Cromarty Bay and Bulls Island and migrate into the Mambo Wetland/Salamander Bay area depending on environmental conditions.

Management Options

Council will continue to implement control measures to limit breeding and reduce adult populations as necessary. The golf course near Mambo Wetland has been identified as a significant stakeholder, and a joint monitoring program should therefore be investigated.

20.0 REVEGETATION

It is anticipated that revegetation will be necessary as weed removal activities are undertaken. Planting with native species as soon as practicable after weeding will minimise the regrowth of introduced species, as well as stabilise the exposed soil against erosion. Revegetation may also be necessary in other disturbed areas of the wetland such as disused tracks and in areas previously sand mined.

Any revegetation works that are undertaken in Mambo Wetland must use local native plant species. Preferably these plants should be grown from seed collected within Mambo Wetland or the nearest local seed source available.

The vegetation community map shown in Figure 3 should be used to guide future plantings in Mambo Wetland. The vegetation community present in the planting site should be identified such that appropriate plant species can be selected. A guide of species suitable for regeneration in each community is provided in Appendix 7.

20.1 Seed Collection

It is important that the plants used for rehabilitation naturally occur in the local area. One way to ensure that endemic species are used is to collect and propagate the seed from the area to be rehabilitated. Where the resources make it possible, it is recommended that plants propagated from seed collected at Mambo Wetland be used for any rehabilitation works within the reserve. Where it is not possible to use seed sourced from Mambo Wetland, seed from the nearest local bushland should be used. Any species planted should be first checked against the species list in Appendix 1 of this document to ensure that it is endemic to Mambo Wetland.

21.0 IMPLEMENTATION PLAN

The following table (Table 4) is an implementation plan, setting out the proposed timetable for the management of each of the issues identified above. This implementation plan shall be incorporated into the annual Port Stephens Council Forward Works Program for 2005 and 2006. Each action has been listed in terms of priority, with those of highest priority listed first. In order to reduce the subjectivity of determining priority, the following criteria have been used as a guideline:

HIGH PRIORITY: *These are issues that require immediate management before the problem becomes too difficult to manage, or significantly impacts on the natural integrity of the wetland. These may not be major issues, but those that have the potential to escalate if left unmanaged. For example, small infestations of weeds with a high rate of dispersal should be given high priority before the infestation becomes too difficult to manage.*

High priority actions should be implemented within 6-12 months of the adoption of the plan of management.

MEDIUM PRIORITY: *These are those issues that are not an immediate threat to the wetland, and will still be manageable if not addressed within the next 1-2 years. An example is urban stormwater – the cost of managing this is unlikely to escalate significantly if delayed.*

Medium priority actions should be implemented within 2 years of the adoption of the plan of management.

LOW PRIORITY: *These are actions that will not significantly escalate within the next 2-4 years. If left alone, the future management of these issues will remain achievable. For example, the threat of future development does not need to be addressed until the need arises, therefore is given a low priority against issues that are an immediate threat.*

Low priority actions should be implemented within 2-4 years of the adoption of the plan of management.

Table 4: Implementation Plan – Schedule of Works.

No	Issue	Proposed Actions	Priority	Desired Outcomes	Performance Measures	Costing
	WEED CONTROL					
1	Infestation of noxious weed - *Ludwigia longifolia* in Mambo Wetland and adjacent wetlands.	▪ Identify and control weed at the source; ▪ Involve bush regenerators in on-ground control works; ▪ Develop a long-term management strategy for Ludwigia; ▪ Implement a monitoring program to assess success of control programs. ▪ Investigate availability of biological control.	High	▪ To contain and reduce the extent of Ludwigia in the wetland. ▪ To prevent the weed spreading further into the wetland. ▪ To prevent the weed spreading to other areas ▪ To assess control programs success.	▪ The area infested by Ludwigia in the wetland is contained and reduced. ▪ Identify the impacts on natural ecosystems. ▪ No further outbreaks of Ludwigia are found.	$20,000 per annum
2	Infestation of noxious weed - *Salvinia molesta* into Mambo Wetland and adjacent wetlands.	▪ Bush regenerators to undertake hand removal. Bag and remove all material off-site; ▪ Introduce biological control and monitor success; ▪ Place boom nets to prevent the spread of Salvinia; ▪ Identify and control the weed at	Medium	▪ To contain and reduce the extent of Salvinia in the wetland. ▪ To prevent the weed spreading further into the wetland. ▪ To prevent the weed spreading to other areas	▪ The area infested by Salvinia in the wetland is contained and reduced. ▪ No new outbreaks are recorded.	$2000 pa

		the source (eg. Sandpiper reserve); ▪ Identify and trial new control techniques; ▪ Educate community against dumping or removing aquatic plants.				

No	Issue	Proposed Actions	Priority	Desired Outcomes	Performance Measures	Costing
3	Infestation of noxious weed – *Alternanthera philoxeroides* (Alligator Weed) in Mambo Wetland and adjacent wetlands.	▪ Continue with spraying program; ▪ Monitor success of spraying program; ▪ Investigate option of biological control; ▪ Monitor the success of biological control; ▪ Contract bush regenerators for hand removal. Bag and remove all material off-site.	Medium	▪ To contain and reduce the extent of Alligator weed in the wetland. ▪ To prevent the weed spreading further into the wetland. ▪ To prevent Alligator weed invading terrestrial ecosystems.	▪ The area infested by Alligator Weed in the wetland is contained and reduced. ▪ Alligator weed remains contained to the aquatic environment.	$2500 pa
4	Potential for future introduction of *Pistia stratiotes* (Water Lettuce) into Mambo Wetland and adjacent wetlands.	▪ Educate community on the identification of the weed; ▪ Educate community on native alternatives to water lettuce for aquarium plants; ▪ Hand remove any infestations as soon as they are observed.	Low	▪ To raise awareness of the weed to ensure early detection and removal. ▪ To remove new infestations before they become unmanageable. ▪ To prevent future introduction of the weed into Mambo Wetland.	▪ Council are notified of new infestations early. ▪ Infestations of water lettuce are contained/eliminated. ▪ No future introductions of water lettuce recorded.	$500 education
5	Infestation of noxious weed – *Chrysanthemoides monilifera* (Bitou Bush).	▪ Hand removal or cut and paint of small infestations; ▪ Mosaic spraying of larger patches of Bitou Bush; ▪ Revegetation using local native species where large areas have	Medium-High	▪ To reduce the area of Bitou Bush occurring in Mambo Wetland. ▪ To encourage the natural regeneration of native plant species.	▪ Area of Bitou Bush successfully contained and reduced. ▪ Regeneration of previously infested areas. ▪ Reduction in spreading	$1000 pa

		been cleared; ▪ Regular follow-up removal of seedlings.		▪ To prevent the further spread of Bitou Bush into undisturbed parts of the wetland.	rate of Bitou Bush.	

No	Issue	Proposed Actions	Priority	Desired Outcomes	Performance Measures	Costing
6	Introduction of exotic garden species /environmental weeds from dumping or dispersal.	▪ Implement the bush regeneration program as outlined in Section 22 of this Management Plan ▪ Education of residents regarding weeds and plants with weed potential that threaten biodiversity; ▪ Regular monitoring to identify new infestations; ▪ Rapid removal of outbreaks to prevent further spread; ▪ Encourage replacement of exotic species in gardens with native plants that do not have weed potential.	High	▪ To reduce the outbreak of exotic garden species/environmental weeds within the reserve.	▪ The occurrence of exotic garden species/environmental weeds is reduced, ▪ Residents remove potential weeds from gardens and replace with appropriate native species	$20,000 pa for bush regeneration works $800 for education Cost of removing new infestations to be determined
STORMWATER AND HYDROLOGY ISSUES						
7	Reduced natural tidal inundation of mangroves.	▪ Widen culvert under Foreshore Drive;	High	▪ To increase the tidal flushing of mangroves.	▪ Severity of flooding after rain is reduced. ▪ Health of mangroves improves with increased tidal flushing.	Approx. $200,000
8	Flooding of properties on Foreshore Drive	▪ Undertake further investigation to determine best option for reducing problem caused by upstream channel narrowing.	Low	▪ To prevent flooding of houses on Foreshore Drive caused by upstream channel narrowing.	▪ Reduced incident of houses flooding.	Cost yet to be estimated
9	Increased runoff	▪ Urban stormwater control throughout	Medium-	▪ To reduce the volume and	▪ More natural water	$300 Education

	volume and velocity as a result of urban development.	the catchment; ▪ Investigate options for retrofitting existing stormwater infrastructure to increase infiltration and treatment of stormwater runoff; ▪ Water Sensitive Urban Design to be a requirement for all new developments.	High	velocity of urban runoff entering Mambo Wetland. ▪ To reduce the severity of high volume water flows in storm events. ▪ To reduce flooding in lower catchment.	regime observed. ▪ Reduction in erosion of creek banks. ▪ Reduction in sediment load of runoff.	Cost of retrofitting stormwater infrastructure to be determined

No	Issue	Proposed Actions	Priority	Desired Outcomes	Performance Measures	Costing
10	Potential impact of stormwater overflows from Salamander Bay shopping centre extensions.	▪ Monitor outflow areas to identify any impacts on the wetland; ▪ Determine need for litter racks in drainage lines entering the wetland.	High	▪ To ensure that changes in runoff volumes does not adversely impacting on Mambo Wetland. ▪ To reduce amount of litter entering the wetland.	▪ Impacts are identified and addressed before major problems accumulate. ▪ No increases in litter as a result of extensions.	No projected cost.
11	Increase in nutrients and sediment entering the wetland system as a result of urban activities and stormwater runoff.	▪ Educate community on how to reduce input of nutrients in stormwater; ▪ Liaise with golf course to develop strategy to reduce nutrient runoff from the greens; ▪ Improve compliance of erosion and sediment control measures on new building sites; ▪ Monitor water quality in the wetland (Waterwatch by community group). ▪ Investigate options for retrofitting existing stormwater infrastructure to remove nutrients and sediments from stormwater runoff.	Medium-High	▪ To reduce nutrients entering the wetland. ▪ To improve water quality for aquatic biota.	▪ Water quality in Mambo Wetland improved ▪ Results of Waterwatch monitoring.	$1000 Education Cost of retrofitting stormwater infrastructure to be determined

No	Issue	Proposed Actions	Priority	Desired Outcomes	Performance Measures	Costing
FAUNA MANAGEMENT						
12	Maintenance of wildlife corridors to link Mambo Wetland with surrounding reserves.	▪ Protect wildlife corridors from future development and disturbance; ▪ Improve the habitat of these corridors where necessary through bush regeneration and tree planting; ▪ Develop urban wildlife corridors where fauna are already known to move by: - street tree planting and landscaping program in appropriate locations - reduced speed limit in known wildlife crossing areas and improved signage of these areas.	Low-medium	▪ To ensure that wildlife corridors are protected. ▪ To ensure viable populations of native animals can survive. ▪ To increase the health of disturbed environments. ▪ Reduce number of fauna killed/injured on roads.	▪ Wildlife corridors are protected against further development. ▪ Sustainable populations of native fauna survive. ▪ Habitat value of corridors is improved for native fauna.	$2000 bush regeneration $3000 native trees $500 signage **Total = $5500** (0ver 2yrs)
13	Decline in habitat for native fauna.	▪ Identify habitat requirements of resident fauna; ▪ Supplement natural nesting hollows with nest boxes; ▪ Monitor success of nest boxes (ensure exotic bees, Indian Mynas etc are not encouraged); ▪ Educate community on habitat	Low	▪ To increase the availability of habitat for native fauna. ▪ To increase awareness of important fauna habitat. ▪ To reduce the decline in habitat for native fauna.	▪ Number of nest boxes installed. ▪ Native fauna utilising nest boxes. ▪ Increase in the number of fauna observed at Mambo Wetland.	$2000 for nest boxes $1000 education $7,000 pa for fauna monitoring program

		protection; ▪ Discourage planting of habitat/food trees in private property where dogs are a threat. ▪ Implement fauna monitoring program.				
No	**Issue**	**Proposed Actions**	**Priority**	**Desired Outcomes**	**Performance Measures**	**Costing**
14	Classification of Koala habitat.	▪ Ground truth the classifications of Port Stephens Koala Habitat Planning Map for Mambo Wetland.	Medium	▪ Accurate identification of koala habitat in Mambo Wetland.	▪ CKPoM modified to reflect ground truthing.	$7,000
15	Protection and restoration of Koala habitat.	▪ Protection of koala habitat trees throughout the reserve, particularly on the buffer edges; ▪ Restoration of koala habitat by re-planting of important food trees in key habitat areas; ▪ Street tree planting program (see action 12).	Medium	▪ To protect the available habitat for koalas in Mambo Wetland. ▪ To restore and enhance disturbed Koala habitat.	▪ Area of Koala habitat increased. ▪ Quality of Koala habitat increased.	No projected cost.
INTRODUCED FAUNA						
16	Introduction of *Gambusia* (Mosquito Fish).	▪ Monitor environmental impacts of *Gambusia* in Mambo Wetland and investigate necessity for control measures.	Low	▪ To evaluate the impacts of *Gambusia* in Mambo Wetland. ▪ To develop a control strategy for *Gambusia* if the	▪ *Gambusia* populations in Mambo Wetland monitored and options available for control measures.	No projected cost.

				need arises.		
17	Potential occurrence of feral animals such as foxes and rabbits.	▪ Co-ordinate with existing feral animal control programs with NPWS; ▪ Discuss management options with the Port Stephens Vertebrate and Pest Management Committee.	Low	▪ To reduce the numbers of feral animals within the reserve. ▪ To reduce competition of feral animals with native fauna.	▪ Reduced reports of feral animal sightings. ▪ Regular monitoring of feral animal populations reveals a reduction in numbers.	No projected cost.

No	Issue	Proposed Actions	Priority	Desired Outcomes	Performance Measures	Costing
18	Impact of domestic pets on native fauna.	▪ Educate residents on the impacts of dogs and cats on native fauna; ▪ Install signs stipulating Mambo Wetland is a dog free area at all access points; ▪ Increased enforcement of dog exclusion rules within the reserve i.e. Increased ranger patrols	High	▪ To prevent dogs and cats from accessing and roaming free within the reserve. ▪ To minimise wildlife injuries from dog and cat attacks.	▪ The number of dogs and cats observed in the reserve reduced. ▪ The number of native fauna killed by domestic animals reduced.	$750 education $3,000 signage
19	Domestic Ducks & Mallard (introduced) in adjacent Sandpiper Reserve	▪ Investigate Mallard population and its impact on the native ducks (interbreeding). ▪ Discourage feeding of ducks through signage. ▪ Investigate relocation of domestic ducks to a more suitable farm location.	Medium	▪ To understand the impacts on water quality and other native ducks in Mambo Wetland ▪ To minimise concentration of duck faeces and consequent nutrient influx.	▪ Mallard Duck population understood so action can be planned if needed. ▪ Number of ducks in reserve at one time reduced.	$300 signage No cost projected for investigations
PUBLIC USE AND ACCESS ISSUES						
20	Negative impacts of motorbike and 4WD access to the reserve.	▪ Install penalty notice signs at all entrances of reserve; ▪ Install locked, sturdy gates at access points. ▪ Enforcement of by-laws and use of infringements.	High	▪ To reduce the impacts of vehicles on the reserve. ▪ To enable the saltmarsh to regenerate.	▪ Reduction in number of vehicles entering the reserve. ▪ Regeneration of areas previously affected by vehicles.	$1,000 signs $2,000 gates

No	Issue	Proposed Actions	Priority	Desired Outcomes	Performance Measures	Costing
21	Edge effects at Wetland/Urban interface.	▪ Provide education to residents about edge effects, such as garden refuse dumping; ▪ Enforce breaches to regulations/ greater ranger visitation; ▪ Organise working bees for the revegetation of the edge-zone (must be compatible with plans for fire protection zones); ▪ Enforcement and ongoing maintenance of Asset Protection Zones.	Medium	▪ To minimise the spread of exotic garden escapees. ▪ To reduce encroachment of mown grass into the reserve. ▪ To reduce litter/rubbish in the reserve. ▪ To increase native vegetation in the edge zone.	▪ Greater awareness of residents about their impact on the reserve. ▪ Reduced incidence of garden plant escapees colonising in the reserve. ▪ Reclamation of mown areas for native vegetation.	$750 Education $1000 for revegetation $7,500 pa for maintenance of Asset Protection Zones
	LITTER					
22	Litter entering Mambo Wetland from Kingfisher Reserve, Sandpiper Reserve and Horizons Golf Course.	▪ Education of local community through signage, pamphlets, newsletters etc.; ▪ Investigate need for litter trap; ▪ Liaise with golf course to assist with litter reduction.	Low	▪ To minimise the amount of litter entering Mambo Wetland.	▪ Reduction in amount of litter observed at the inflow to Mambo near Kingfisher reserve and Horizons Golf Course.	$750 Education

No	Issue	Proposed Actions	Priority	Desired Outcomes	Performance Measures	Costing
PROTECTION AGAINST DEVELOPMENT						
23	Protect Mambo Wetland from further development.	▪ Investigate options for highest level of protection for Mambo Wetland eg. wildlife refuge, dedicating the reserve though State Government gazette etc. ▪ Seek clarification of intended usage of adjacent land owned by NSW Department of Education and note desire to include this land within the wetland reserve if possible. ▪ Educate community about edge effects and rubbish dumping. ▪ Surrounding and future development must maintain buffers to protect wetland asset.	Medium	▪ To enhance and promote the natural attributes of the site. ▪ Clarification of intended usage of adjacent NSW Education land. ▪ To reduce edge effects from development. ▪ To protect wetland from encroachment by development.	▪ Mambo Wetland adequately protected from development	No projected cost.
FORESHORE EROSION						
24	Erosion of foreshore from illegal boat launching and recreational fishers	▪ Install gates to exclude boat access to the foreshore ▪ Install signage indicating penalties for illegal boat launching in non-designated areas ▪ Investigate the degree of erosion caused by recreational	Medium	▪ To regenerate native vegetation on disturbed foreshore areas ▪ To reduce sedimentation of the Bay	▪ Vegetation on disturbed areas is re-established ▪ Amount of sediment entering the bay from foreshore erosion is reduced.	$1500 gates and signage

		fishers ▪ Monitor natural regeneration of disturbed areas ▪ Supplement natural regeneration with plantings and erosion control works where necessary				

No	Issue	Proposed Actions	Priority	Desired Outcomes	Performance Measures	Costing
FIRE MANAGEMENT						
25	Maintenance of fire trails	▪ Re-routing of fire trails to facilitate ease of fire management; ▪ Ensure fire trails are maintained to allow vehicle access in the event of fire; ▪ Keep trails locked to exclude unauthorised vehicle usage.	High	▪ To enable fire personnel safe access and in and out of the reserve.	▪ Fire trails suitable for access from fire vehicles to access.	No projected costs.
26	Asset Protection Zones	▪ Ensure asset protection zones are adequately maintained to protect life and property and the natural value of Mambo Wetland. ▪ Ensure contractors are supervised so APZs are not continually widened during maintenance. ▪ Ensure continued liaison between Council, RFS, Mambo Wetland Committee and NATF to protect habitat.	Medium	▪ To protect life and property from fire; ▪ To protect natural values of Mambo Wetland.	▪APZ's maintained and native vegetation protected as described.	No projected cost.

27	Undertake Bush Fire Risk Education Program for community	▪ Educate residents on reducing bush fire hazard on their property; ▪ Encourage community participation in managing bush fire risk; ▪ Keep community well-informed on bush fire protection measures.	High	▪ To ensure community are aware of their role in reducing bush fire risk and how they can achieve this.	▪ Community recognises and implements strategies to reduce the risk of fire on their property.	$750 Education

No	Issue	Proposed Actions	Priority	Desired Outcomes	Performance Measures	Costing
28	Mosaic Control Burning	▪ Initiate a periodic, mosaic burning regime for areas indicated in Figure 20a. ▪ Adjust this regime in the event of unplanned fire in SFAZs.	Medium	▪ To reduce the severity of bush fires; ▪ To ensure the safety of fire fighting personnel; ▪ To enable areas of vegetation to remain unburnt; ▪ To ensure areas of bushland are retained for wildlife refuge.	▪ Reduced severity of subsequent fires; ▪ Areas of bushland remain unburnt as wildlife refuges in subsequent fires.	No projected cost.
MOSQUITOES						
29	Mosquito populations as potential disease vectors and the reduction of public enjoyment of the environment	▪ Monitor mosquito populations and undertake control programs such as adulticide, larvicide and habitat modification. ▪ Co-ordinate control programs with key stakeholders. ▪ Educate and advise the community about this issue.	Low	▪ To reduce the numbers of mosquitoes; ▪ To minimise the risk of mosquito vectored diseases; ▪ To reduce the frequency and severity of mosquito outbreaks.	▪ Mosquito numbers reduced; ▪Incidences of mosquito borne diseases reduced.	Cost to be determined
PERIOD FOR REVIEW						
30	Monitoring progress of the implementation of the Mambo Wetland Plan of Management (PoM)	▪ Plan to be review every three years ▪ Monitoring of progress to be undertaken annually.		▪ To ensure continued relevance of the PoM ▪ To ensure implementation of the recommendations of the PoM.	▪ Mambo Wetland appropriately managed to protect and enhance the community asset.	No cost projected

22.0 WEED MANAGEMENT AND BUSH REGENERATION IMPLEMENTATION PLAN

WEED MANAGEMENT AND BUSH REGENERATION IMPLEMENTATION PLAN

Management of weed infestations at Mambo Wetland should be undertaken in accordance with the prioritisations shown in Figure 13. The infestations have been divided into eight key management areas, four of which contain terrestrial weeds. Following is a description of each of these areas and the management actions that are required for each.

Weed Management Zone 1: Stormwater Entry Points along Sandy Point Road

These sites are heavily infested with Ludwigia (*Ludwigia longifolia*) along the wet edges of the outflow pipes and in amongst the perched Gahnia swamps. The locality and general inaccessibility of these sites to manual removal techniques will necessitate access trails to be established to allow for primary weeding to commence and maintenance of these sites over time. The use of floating pontoons to enable weeding in the perched swamp areas also needs to be investigated. The potential threat that this weed poses to the wetlands ecosystem is not to be taken lightly and it is imperative that containment measures be instigated immediately in conjunction with trials and research into suitable long term control measures.

One of the outflow points previously contained a small occurrence of Water Lettuce (*Pistia stratiotes)* and will require regular monitoring for recurrence as the source was undetermined at the time. Small infestations of Lantana (*Lantana camara)* and Bitou Bush **(***Chrysanthemoides monilifera*) occur along the fringes of the wetland, they will be treated accordingly within the maintenance weeding regime. Around the sewage treatment pumping site the plantings of Pussy Willow (*Salix cinerea)* will need to be addressed.

Weed Management Zone 2: Sandpiper Reserve

The wetland system at Sandpiper Reserve that feeds into Mambo Wetland contains a healthy infestation of Salvinia (*Salvinia molesta).* Containment booms have been placed in the wetland system, however more need to be installed to prevent weed propagules entering the Mambo Wetland system. Along the stormwater entry points into the wetland, Ludwigia (*Ludwigia longifolia*) has established along the open banks and areas where deposition of sediment has created mini islands within the wetland. This area is currently undergoing containment in the form of removal of the mature plants to reduce the amount of seed set.

The Mambo system has an infestation of Ludwigia (*Ludwigia longifolia*) along the edges of the overflow between the two systems and a separate pond that is fed by stormwater flows off Salamander Way. These two areas have also been primary weeded with removal of mature plants to date.

Weed Management Zone 3: Drainage Line off Salamander Way

The major weeds occurring in this zone are Ludwigia (*Ludwigia longifolia*) and Alligator Weed (*Alternanthera philoxeroides*). The control of these weeds is considered high priority due to the ability of these species to colonise rapidly. Despite the recognised need for management of aquatic weeds, there has been little success in the control of these weeds in the past. Further research needs to be undertaken in order to develop a feasible strategy for the management of aquatic weeds. Council Weed Officers will endeavour to trial new control techniques as they become available.

In addition to aquatic weeds, this management zone contains scattered Bitou Bush seedlings. It is recommended that follow-up removal of these should be undertaken before the seedlings set seed. This will assist in the long-term eradication of Bitou Bush from the wetland. Control techniques should involve hand removal only. No bushes in this zone are large enough to warrant spraying or cut and paint.

Weed Management Zone 3a: Drainage Line off Bosuns Place

The aquatic weed *Ludwigia peruviana* has colonised the drainage line in this area and is the target weed in this zone. Similar to zones 1, 2 & 3 there are few successful control methods of Ludwigia known. At this stage the mature plants have been removed and the drainage line is being monitored for seedling regrowth. Further research will be required to develop a suitable control program for this weed.

Weed Management Zone 4: Mariner Drive

The target weed in this zone is Bitou Bush (*Chrysanthemoides monilifera*) which occurs in low to medium density. The disturbance of this area from sand mining has likely resulted in this infestation. This is probably the last significant stand of Bitou Bush within the reserve, therefore it is considered a high priority area. It is important to manage this infestation to avoid re-colonisation of this weed in other areas of the wetland.

Activities to be undertaken in this area will involve the primary removal of large shrubs and follow-up hand removal of regenerating seedlings. Primary removal work will involve hand removal or cut and paint techniques.

Where there has been a large area of Bitou Bush removed, immediate planting will be necessary to prevent the destabilisation of the sand dunes, and to inhibit the germination of Bitou Bush seedlings. This weed management area occurs within the Coastal Sand Woodland. It should be noted that in some areas Pig Face (*Carpobrotus glaucescens*) is recolonising the dunes. Clumps of this plant can be divided and replanted. It is suggested that this be undertaken to revegetate bare areas hence preventing erosion. The revegetation of this site will be opportunistic depending upon availability of labour, appropriate plants and local rainfall patterns. No formalised revegetation strategy is proposed for this site due to the large number of variables inherent in undertaking such works.

Weed Management Zone 5: Salamander Shopping Centre Buffer

The target weed in this zone is Golden Wreath Wattle *(Acacia saligna)* which is gradually increasing in distribution and densities along the edge of the shopping centre and the wetland edge. Future proposals for the neighbouring site include extensions of the carpark which will place greater edge effects upon the reserve .

Also this site has isolated patches of Lantana and Bitou Bush that will be monitored for increases in density and distribution and will be scheduled into future works for removal when resources become available.

Weed Management Zone 6: Isolated Patch of Freesia/ Cotton Bush

An isolated patch of introduced Freesia and Cotton Bush is present along the pathway/saltwater edge within Mambo Wetland (shown in Figure 13). This is not considered a high priority area, however management of this weed should be undertaken before the infestation becomes too difficult to manage. Appropriate bush regeneration techniques should be undertaken to ensure the effective removal of this weed.

Weed Management Zone 7 : Foreshore Drive

This zone is considered to be of low priority due to the high level of weed infestation and disturbance. According to bush regeneration principles, weed management should work from the best to worst areas. Taking the whole wetland reserve into perspective, this is one of the worst areas in terms of weed infestation. A suite of weeds including Coral Tree (*Erythrina X sykesii*), Lantana (*Lantana camara*), Bitou Bush (*Chrysanthemoides monilifera*), Mother of Millions (*Bryophyllum delagoense*) and *Acacia saligna* have also been identified in this area.

Given that this area is situated in a roadside environment, it receives a high level of disturbance and a constant source of new weeds from vehicles and walkers. Taking this into consideration, the complete eradication of weeds from this strip will be realistically quite difficult. In the long-term, however, a reduction in the density of weeds should be managed, as this area will become a major source of weed seeds which may threaten other areas of the wetland that are currently weed free.

Long-term management of this area will involve the gradual removal of target weeds with bush regeneration techniques appropriate to the individual weed. Weed removal should be followed up immediately with mulching and planting with appropriate native plant species. This weed management area occurs within the Paperbark/Swamp Oak Complex. A list of species recommended for planting in this community is included in Appendix 5.

Weed Management Zone 8: Cycleway

This zone primarily consists of perennial weeds occurring along the cycleway, however there is the occasional Lantana and Bitou Bush occurring. Some of the perennial weeds present include Pennywort (*Hydrocotyle bonariensis*), Cobbler's Peg (*Bidens pilosa*), Plantain (*Plantago lanceolata*) and Fireweed (*Senecio madagascariensis*). It is considered that the perennial weeds are not likely to impact significantly on the diversity of vegetation in the wetland, therefore should not be given priority. However, when eradication of the more significant weeds is achieved, efforts can be put into the management of weeds in this zone.

Due to the high density of herbaceous weeds, hand removal or herbicide spraying are recommended for control. Care should be taken to avoid native plant species where possible. The weeded area should subsequently be mulched and planted with appropriate native species.

Given the low density of Bitou Bush and Lantana in this zone, they should be considered higher priority than the perennial weeds. Due to the low density infestation, eradication should be a realistic goal. Removal of these weeds should be undertaken before it spreads and becomes too difficult to manage. Control of Bitou Bush and Lantana should include hand removal of seedlings and cut and paint techniques for larger bushes.

Long-term control of weeds in this zone will be difficult due to edge effects associated with the adjacent cycleway and residential areas.

23.0 MONITORING AND EVALUATION

It is important that regular monitoring is undertaken to ensure that the strategies detailed in this plan are being implemented successfully. Monitoring can help to determine whether the health of the environment is declining, stable or improving as a result of the implementation of the management strategies. Monitoring sets up for early warning identification of management issues before they become too difficult to manage.

Ongoing monitoring provides the basis for adopting and modifying the critical elements of the management process if necessary. The information obtained from monitoring can also be useful when applying for funding, as it demonstrates what has been achieved, as well as demonstrating a strong commitment to the project.

23.1 Weed Mapping

Regular review of weed infestations within the reserve is important and should be undertaken annually. Regular weed mapping helps to identify new infestations and the up-to-date weed maps can be used to direct future weed control activities. These maps should include the weed species present as well as the location and density of the infestation. The colour codes outlined in Table 5 below should be used to standardise all maps prepared.

Table 5: Codes for mapping weed infestations

Colour Code	Bushland Condition	Description	Intervention Required
Green	**Good**	Virtually weed free.	**Minimal:** Prevention of further impact, removal of possible scattered weeds.
Blue	**Fair**	Healthy native community	**Low:** Requires removal of impact and of small amounts of weeds.
Orange	**Poor**	Minor weed infestation	**Medium:** Removal of impact and of weed. Needs a 'kickstart' to promote natural regeneration (eg. Fire, planting etc).
Red	**Very Poor**	Weeds dominate site	**Medium or High:** Ability of system to recover is lost, so requires a kickstart. Reconstruction of original system may be necessary.

23.2 Photo-point Monitoring

It is recognised that visual evidence is a very effective mode of recording progress. It is therefore recommended that a monitoring plan should include photo-point monitoring. Permanent photo points should be set up at strategic locations within Mambo Wetland. Suitable areas may include sites of weed removal activities, revegetation areas, regenerating tracks and burnt areas to monitor regeneration after fire. These points should be marked such that the same spot can be photographed time after time.

23.3 Review of Implementation Plan

The monitoring program should include a review of the implementation plan (Table 4) twice a year. These reviews should identify which strategies have been implemented and those which still need to be addressed. The success of those strategies implemented should be assessed in terms of whether the specified outcomes have been achieved. Performance measures for each strategy are outlined in

Table 4 to assist with this assessment. The results of these evaluations shall be recorded and are to be considered in subsequent reviews of the Mambo Wetland Plan of Management.

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Appendix 1 – Flora Species List

Mambo Wetland Flora Species List

Family	*Scientific Name*	Common Name	Record
MIMOSACEAE	**Acacia podalyriifolia*	Queensland Silver Wattle	1, 2
MIMOSACEAE	**Acacia saligna*	Golden Wreath Wattle	1
ASTERACEAE	**Ageratina adenophora*	Crofton Weed	1, 3
PRIMULACEAE	**Anagallis arvensis*	Pimpernael	1
ASTERACEAE	**Aster subulatus*	Wild Aster	1
ASTERACEAE	**Bidens pilosa*	Farmers Friend/Cobbler's Peg	1
POACEAE	**Briza maxima*	Quaking/Shivery Grass	1, 4
CRASSULACEAE	**Bryophyllum delanogense*	Mother-of Millions	1, 3
GENTIANACEAE	**Centaurium erythraea*	Common Centaury	1
ASTERACEAE	**Chrysanthemoides monilifera subsp. rotundata*	Bone Seed/Bitou Bush	1
LAURACEAE	**Cinnamomum camphora*	Camphor Laurel	1, 3
ASTERACEAE	**Conyza canadensis*	Canadian Fleabane	1
ASTERACEAE	**Cosmos bipinnatus*	Cosmos	1
CYPERACEAE	**Cyperus eragrotis*	Umbrella Sedge	1
APIACEAE	**Hydrocotle bonariensis*	Kurnell Curse	1, 3
VERBENACEAE	**Lantana camara*	Lantana	1
ONAGRACEAE	**Oenothera stricta*	Common Evening Primrose	1
POACEAE	**Paspalum dilatatum*	Paspalum	1, 4
PLANTAGINACEAE	**Plantago lanceolata*	Lamb's Tongue	1
EUPHORBIACEAE	**Ricinus communis*	Castor Oil Bush	1
POLYGONACEAE	**Rumex crispus*	Curled Dock	1
SALVINIACEAE	**Salvinia molesta*	Salvinia	1, 3
ASTERACEAE	**Senecio madagascariensis*	Fireweed	1
POACEAE	**Setaria geniculata*	Slender Pidgeon Grass	1
MALVACEAE	**Sida rhombifolia*	Paddys Lucerne	1
ASTERACEAE	**Solvia pterosperma*	Bindii	1
ASTERACEAE	**Taraxacum officinale*	Dandelion	1
FABACEAE	**Trifolium arvense*	Hare's Foot Clover	1
VERBENACEAE	**Verbena bonariensis*	Purple Top	1
ASTERACEAE	**Xanthium occidentale*	Noogoora Burr	1
MIMOSACEAE	*Acacia binervia*	Two-veined Hickory Wattle	1, 2
MIMOSACEAE	*Acacia decurrens*	Green Wattle	1
MIMOSACEAE	*Acacia elongata*		1, 2, 4
MIMOSACEAE	*Acacia falcata*	Sickle Wattle	1
MIMOSACEAE	*Acacia floribunda*	White Sallow Wattle	3
MIMOSACEAE	*Acacia irrorata*	Black Wattle	1, 2, 3
MIMOSACEAE	*Acacia longifolia var sophorae*	Coastal Wattle	1, 2, 3, 4
MIMOSACEAE	*Acacia myrtifolia*	Myrtle Wattle	1
MIMOSACEAE	*Acacia suaveolens*	Sweet Scented Wattle	1, 4
MIMOSACEAE	*Acacia terminalis*	Sunshine Wattle	1, 2, 4
MIMOSACEAE	*Acacia ulicifolia*	Prickly Moses	1, 2, 3, 4
ORCHIDACEAE	*Acianthus caudatus*		1, 4
ORCHIDACEAE	*Acianthus fornicatus*	Pixie Cap Orchid	1, 4
APIACEAE	*Actinotus helianthi*	Flannel Flower	1, 2, 3, 4
ADIANTACEAE	*Adiantum aethiopicum*	Maidenhair Fern	1
MYRSINACEAE	*Aegiceras corniculatum*	River Mangrove	1
POACEAE	*Agrostis avenacea*	Blow Grass	1
CASUARINACEAE	*Allocasuarina littoralis*	Black She Oak	3

Family	*Scientific Name*	Common Name	Record
CASUARINACEAE	*Allocasuarina torulosa*	Forest Oak	1
AMARANTHACEAE	*Alternanthera pungens*	Khaki Weed	1
ASTERACEAE	*Ambrosia tenuifolia*	Rag Weed	1
EUPHORBIACEAE	*Amperea xiphoclada*	Broom Spurge	1, 4
LORANTHACEAE	*Amyema congener*	Mistletoe	1
LORANTHACEAE	*Amyema quandang*	Mistletoe	1
MYRTACEAE	*Angophora costata*	Smooth-barked Apple/Sydney Red Gum	1, 2, 3, 4
MYRTACEAE	*Angophora floribunda*	Rough-barked Apple	1, 2, 3
MYRTACEAE	*Angophora inopina#*		1
FABACEAE	*Aotus ericoides*	Common Aotus	1, 4
EPACRIDACEAE	*Astroloma pinifolium*	Cranberry Heath	1, 2, 4
ARALIACEAE	*Astrotricha latifolia*		1, 4
AVICENNIACEAE	*Avicennia marina*	Grey Mangrove	1, 3
SCROPHULARIACEAE	*Bacopa monniera*		4
MYRTACEAE	*Baeckea diosmifolium*		3, 4
MYRTACEAE	*Baeckea imbricata*	Heath-myrtle	4
PROTEACEAE	*Banksia aemula*	Wallum Banksia	1, 4
PROTEACEAE	*Banksia integrifolia*	Coast Banksia	1, 3
PROTEACEAE	*Banksia robur*	Large-leaf/Swamp Banksia	1, 2, 3
PROTEACEAE	*Banksia serrata*	Saw-tooth Banksia	1, 2, 3, 4
PROTEACEAE	*Banksia spinulosa*	Hairpin Banksia	3
BAUERACEAE	*Bauera capitata*		1, 4
CYPERACEAE	*Baumea arthrophylla*		1
CYPERACEAE	*Baumea articulata*	Jointed Twig Rush	4
CYPERACEAE	*Baumea juncea*		1, 4
CYPERACEAE	*Baumea juncea*	Twig Rush	4
CYPERACEAE	*Baumea rubiginosa*	Soft Twig Rush	4
CYPERACEAE	*Baumea teretifolia*	Wrinkle Nut	1
PITTOSPARACEAE	*Billardiera scandens*	Apple Berry	1, 4
BLANDFORDIACEAE	*Blandfordia grandiflora*	Large Christmas Bells	1, 4
BLECHNACEAE	*Blechnum indicum*	Swamp Water-Fern	1, 3
RUTACEAE	*Boronia parviflora*		3, 4
RUTACEAE	*Boronia pinnata*		4
RUTACEAE	*Boronia sp.*		1, 2
FABACEAE	*Bossiaea ensata*	Sword Bossiaea	1, 4
FABACEAE	*Bossiaea heterophylla*	Variable Bossiaea	1, 2, 3, 4
FABACEAE	*Bossiaea rhombifolia*	Appressed Bossiaea	1, 2, 4
FABACEAE	*Bossiaea scolopendria*		1, 2
EPACRIDACEAE	*Brachyloma daphnoides*	Daphne Heath	1
EUPHORBIACEAE	*Breynia oblongifolia*	Coffee Bush/Dwarfs Apple	1, 3
COLCHICACEAE	*Burchardia umbellata*	Milkmaids	1, 3, 4
BURMANNIACEAE	*Burmannia disticha*		1, 4
PITTOSPARACEAE	*Bursaria spinosa*	Black Thorn	1
LILIACEAE	*Caesia parviflora*	Pale Grass-lily	1, 4
ORCHIDACEAE	*Caladenia alba*	Orchid	1, 4
ORCHIDACEAE	*Caladenia carnea*	Orchid	1, 4
ORCHIDACEAE	*Caladenia catenata*	White Fingers	1, 4
ORCHIDACEAE	*Caladenia hillmannii*		3
ORCHIDACEAE	*Caleana major*	Large Duck Orchid	1, 3, 4
MYRTACEAE	*Callistemon citrinus*	Crimson Bottle-brush	1, 4

Family	*Scientific Name*	Common Name	Record
MYRTACEAE	*Callistemon linearifolius#*	Bottlebrush	1
MYRTACEAE	*Callistemon pachyphyllus*	Wallum Bottlebrush	1, 2, 4
MYRTACEAE	*Callistemon salignus*	Willow Bottlebrush	3, 4
ORCHIDACEAE	*Calochilus robertsonii*	Purple Beard Orchid	1, 4
DICKSONIACEAE	*Calochlaena dubia*	False Bracken	1, 2
BRASSICACEAE	*Capsella bursa-pastoris*	Shepherds Purse	1
CYPERACEAE	*Carex appressa*		3, 4
AIZOACEAE	*Carpobrotus glaucescens*	Pig Face	1, 2, 3
CASSYTHACEAE	*Cassytha glabella forma glabella*	Slender Dodder-laurel/Devils twine	1, 3, 4
CASSYTHACEAE	*Cassytha paniculata*	Devil's Twine	1
CASUARINACEAE	*Casuarina glauca*	Swamp Oak	1, 2, 3, 4
CYPERACEAE	*Caustis flexuosa*	Old Man's Beard	1, 4
CYPERACEAE	*Caustis recurvata*		4
CUNONIACEAE	*Ceratopetalum gummiferum*	Christmas Bush	1, 4
Sschizaeaceae	*Cheilanthes sieberi*	Mulga Fern	1
ORCHIDACEAE	*Chiloglottis reflexa*	Ant Orchid	4
VERBENACEAE	*Clerodendron tomentosum*	Hairy Clerodendron	1, 2
POLYGALACEAE	*Comesperma defoliatum*	Fairies' Wings	4
POLYGALACEAE	*Comesperma ericinum*	Heath Milkwort / Matchheads	1, 4
POLYGALACEAE	*Comesperma volubile*	Love Creeper	1
COMMELINACEAE	*Commelina cyanea*	Wandering Dew/Creeping Christian	1, 3
PROTEACEAE	*Conospermum taxifolium*	Variable Smoke-bush	1, 2, 4
RUTACEAE	*Correa reflexa var. reflexa*	Common Correa	1, 4
ORCHIDACEAE	*Corybas pruinosus*	Toothed Helmet Orchid	1, 4
MYRTACEAE	*Corymbia gummifera*	Red Bloodwood	1, 3, 4
MYRTACEAE	*Corymbia maculata*	Spotted Gum	3
ASTERACEAE	*Cotula coronopifolia*	Water Buttons	1, 4
ORCHIDACEAE	*#Cryptostylis hunteriana*		1
SAPINDACEAE	*Cupaniopsis anacardioides*	Tuckeroo	1
THELYPTERIDACEAE	*Cyclosorus interuptus*		4
ORCHIDACEAE	*Cymbidium suave*	Tree Orchid	1
POACEAE	*Cynodon dactylon*	Common Couch	1
CYPERACEAE	*Cyperus sanguinolentus*	Sedge	4
ALISMATACEAE	*Damasoinum minus*	Star Fruit	4
GOODENIACEAE	*Dampiera stricta*	Blue Dampiera	1, 3, 4
MYRTACEAE	*Darwinia leptantha*		4
FABACEAE	*Daviesa ulicifolia*		3
FABACEAE	*Daviesia acicularis*	Bitter Pea	1
FABACEAE	*Daviesia corymbosa*		1, 4
ORCHIDACEAE	*Dendrobium teretifolium*	Orchid	1, 4
LORANTHACEAE	*Dendropthoe vitellina*	Mistletoe	1, 4
FABACEAE	*Desmodium varians*		1, 3
LILIACEAE	*Dianella caerulea*	Blue Flax-Lily	1, 2, 3, 4
POACEAE	*Dichelacne crinita*	Long-hair Plume Grass	1, 2
LILIACEAE	*Dichopogon fimbriatus*	Nodding Chocolate Lily	4
CONVOLVULACEAE	*Dicondra repens*	Kidney Weed	1
POACEAE	*Digitaria sp*	Fingergrass	1, 2
FABACEAE	*Dillwynia floribunda*		3, 4
FABACEAE	*Dillwynia glaberrima*		1, 4

Family	*Scientific Name*	Common Name	Record
FABACEAE	*Dillwynia retorta*	Small-leaf Parrot-pea	1
DIOSCOREACEAE	*Dioscorea transversa*	Native Yam	1
ORCHIDACEAE	*Dipodium punctatum*	Orchid	1, 4
ORCHIDACEAE	*Diuris aurea*	Golden Donkey Orchid	1, 4
ORCHIDACEAE	*Diuris sulphurea*	Tiger Orchid	1, 4
SAPINDACEAE	*Dodonaea triquetra*	Long-leaf Hop-bush/Hopbush	1, 2, 3, 4
BLECHNACEAE	*Doodia aspera*	Rasp Fern	1
DROSERACEAE	*Drosera auriculata*	Sundew	1, 4
DROSERACEAE	*Drosera binata*	Forked Sundew	1, 3, 4
DROSERACEAE	*Drosera peltata*	Sundew	1, 3, 4
DROSERACEAE	*Drosera spathulata*	Common Sundew	1, 4
ELAEOCARPACEAE	*Elaeocarpus reticulatus*	Blue Berry Ash	1
CYPERACEAE	*Eleocharis acuta*	Common Spike-rush	1
CYPERACEAE	*Eleocharis sphacelata*	Tall Spike-Rush	1, 3
LAURACEAE	*Endiandra seiberi*	Cork Wood	1
POACEAE	*Entolasia stricta*		4
EPACRIDACEAE	*Epacris microphylla*	Coral Heath	1, 4
EPACRIDACEAE	*Epacris obtusifolia*	Blunt-leaf Heath	1, 4
EPACRIDACEAE	*Epacris paludosa*	Swamp Heath	1
EPACRIDACEAE	*Epacris pulchella*	WallumHeath	1, 3, 4
POACEAE	*Eragrostis brownii*	Brown's Love Grass	4
ERIOCAULACEAE	*Eriocaulon scariosum*		1, 4
RUTACEAE	*Eriostemon australasius*	Wax Plant/Pink Waxflower	1, 2, 3, 4
POACEAE	*Eucalyptrus pilularis*	Blackbutt	1
MYRTACEAE	*Eucalyptus botryoides*	Bangalay	1, 2
MYRTACEAE	*#Eucalyptus camfieldii*	Heart-leaved Stringybark	1
MYRTACEAE	*Eucalyptus capitellata*	Brown Stringybark	1
MYRTACEAE	*#Eucalytpus glaucina*		1
MYRTACEAE	*Eucalyptus microcorys*	Tallow Wood	1
MYRTACEAE	*#Eucalyptus nicholii*	Narrow-leaved Peppermint	1
MYRTACEAE	*Eucalyptus paniculata*	Grey Iron Bark	1
MYRTACEAE	*Eucalyptus piperita*	Sydney Peppermint	1
MYRTACEAE	*Eucalyptus punctata*	Grey Gum	1, 2
MYRTACEAE	*Eucalyptus robusta*	Swamp Mahogany	1, 2, 3, 4
MYRTACEAE	*Eucalyptus sieberi*	Black Ash	1
MYRTACEAE	*Eucalyptus tereticornis*	Forest Red Gum	1, 4
PHILESIACEAE	*Eustrephus latifolius*	Wombat Berry	1, 3, 4
SANTALACEAE	*Exocarpos cupressiformis*	Native Cherry	1, 2, 3
MORACEAE	*Ficus coronata*	Sand Paper Fig	1
MORACEAE	*Ficus rubiginosa*	Port Jackson Fig	1
CYPERACEAE	*Fimbristylis dichotoma*		1
CYPERACEAE	*Gahnia aspera*	Large saw grass	1
CYPERACEAE	*Gahnia clarkei*	Saw Sedge	1, 2
CYPERACEAE	*Gahnia sieberiana*	Red-fruit Saw-sedge	1, 3, 4
LUZURIAGACEAE	*Geitonoplesium cymosum*	Scrambling Lily	1
GLEICHENIACEAE	*Gleichenia dicarpa*	Pouched Coral Fern	1, 2, 3, 4
GLEICHENIACEAE	*Gleichenia microphylla*	Coral Fern	1
EUPORBIACEAE	*Glochidion ferdinandi*	Cheese tree	1, 2, 3
ORCHIDACEAE	*Glossodia minor*	Wax Lip Orchid	1, 4
FABACEAE	*Glycine clandestina*	Twining glycine	1, 3, 4
ASTERACEAE	*Gnaphalium canadidissimum*	Cudweed	1

Family	*Scientific Name*	Common Name	Record
ASCLEPIADACEAE	*Gomphocarpus fruiticosus*	Wild Cotton Bush	1
FABACEAE	*Gompholobium latifoliam*	Giant Wedge-pea	1, 3, 4
FABACEAE	*Gompholobium pinnatum*	Pinnate Wedge-pea	1, 4
HALORAGACEAE	*Gonocarpus micranthus*	Creeping Raspwort	1, 4
HALORAGACEAE	*Gonocarpus teucriodes*	Germander Raspwort	1, 4
GOODENIACEAE	*Goodenia bellidifolia*	Daisy-leaved Goodenia	1, 4
GOODENIACEAE	*Goodenia hederacea*	Violet-leaved Goodenia	4
GOODENIACEAE	*Goodenia heterophylla*	Variable-leaved Goodenia	1, 4
GOODENIACEAE	*Goodenia ovata*	Hop Goodenia	1, 4
GOODENIACEAE	*Goodenia stelligera*	Star Haired Goodenia	1, 4
PROTEACEAE	*Grevillea granulifera*		1
HAEMODORACEAE	*Haemodorum planifolium*	Blood Root	1, 4
PROTEACEAE	*Hakea salicifolia*	Willow-leaved Hakea	1
PROTEACEAE	*Hakea sericea*	Needle Wood	1, 3
PROTEACEAE	*Hakea teretifolia*	Dagger Hakea	4
FABACEAE	*Hardenbergia violacea*	Purple Coral-pea/False Sasparilla	1, 3, 4
ASTERACEAE	*Helichrysum diosmifolium*	Paper Daisy	4
POACEAE	*Hemarthria uncinata*	Mat Grass	1
DILLENIACEAE	*Hibbertia aspera*	Rough Guinea Flower	1, 4
DILLENIACEAE	*Hibbertia dentata*	Twining guinea flower	1
DILLENIACEAE	*Hibbertia diffusa*	Guinea Flower	1, 4
DILLENIACEAE	*Hibbertia faciculata*		4
DILLENIACEAE	*Hibbertia linearis*	Guinea Flower	1
DILLENIACEAE	*Hibbertia monogyna*	Leafy Guinea Flower	1, 4
DILLENIACEAE	*Hibbertia obtusifolia*	Grey Guinea Flower	1, 2, 4
DILLENIACEAE	*Hibbertia scandens*	Golden Guinea Flower	1, 3, 4
DILLENIACEAE	*Hibbertia sericea*	Guinea Flower	1, 4
DENNSTAEDTIACEAE	*Histiopteris incisa*	Bats-wing Fern	1
FABACEAE	*Hovea linearis*	Common Hovea	1, 4
APIACEAE	*Hydrocotyle bonariensis*	Penny Wort	1
RESTIONACEAE	*Hypolaena fastigata*	Tassel Rope-rush	4
POACEAE	*Imperata cylindrica var major*	Blady Grass	1, 2, 3, 4
FABACEAE	*Indigofera australis*	Native Indigo	1
CONVOLVULACEAE	*Ipomoea purpurea*	Common Morning Glory	1
CYPERACEAE	*Isolepis nodosa*		1
CYPERACEAE	*Isolepsis inundatus*		4
PROTEACEAE	*Isopogon anemonifolius*	Drumsticks	4
PROTEACEAE	*Isopogon anethifolius*	Drumsticks	3
JUNCACEAE	*Juncus continuus*	Rush	1
JUNCACEAE	*Juncus kraussii*	Sea Rush	1
JUNCACEAE	*Juncus planifolius*	Broad-leaf Rush	4
JUNCACEAE	*Juncus usitatus*	Common Rush	1, 3, 4
FABACEAE	*Kennedia rubicunda*	Dusky Coral-pea/Running Postman	1, 3, 4
MYRTACEAE	*Kunzea ambigua*	Tick Bush	1
PROTEACEAE	*Lambertia formosa*	Mountain Devil	1
CYPERACEAE	*Lepidosperma flexuosum*	Rapier Sedge	4
CYPERACEAE	*Lepidosperma limicola*	Sword Sedge	1
RESTIONACEAE	*Leptocarpus tenax*	Slender Twine-rush	1, 4
SANTALACEAE	*Leptomeria acida*	Sour Current-bush/Native Currant	1, 2, 4

Family	*Scientific Name*	Common Name	Record
MYRTACEAE	*Leptospermum arachnoides*	Stiff Tea-tree	1, 4
MYRTACEAE	*Leptospermum attenuatum*	Paperbark Tea-tree	1, 4
MYRTACEAE	*Leptospermum juniperinum*	Prickly Tea-tree	1, 4
MYRTACEAE	*Leptospermum laevigatum*	Coastal Tea Tree	1, 2
MYRTACEAE	*Leptospermum parvifolium*	Tea Tree	4
MYRTACEAE	*Leptospermum polygalifolium*	Yellow Tea Tree	1, 3
MYRTACEAE	*Leptospermum trinervium*	Tea tree	1
RESTIONACEAE	*Lepyrodia gracilis*	Slender Scale-rush	4
RESTIONACEAE	*Lepyrodia muelleri*	Scale Rush	4
EPACRIDACEAE	*Leucopogon ericoides*	Bearded Heath	4
EPACRIDACEAE	*Leucopogon esquamatus*	Beard-Heath	1, 4
EPACRIDACEAE	*Leucopogon juniperinus*	Long-flower Beard-heath	1
EPACRIDACEAE	*Leucopogon lanceolatus*	Lance Beard-heath	1, 4
LINDSAEACEAE	*Lindsaea linearis*	Screw Fern	1
ARECACEAE	*Livistona australia*	Cabbage Tree Palm/Cabbage Palm	1
LOBELIACEAE	*Lobelia gracilis*		1, 4
LOMANDRACEAE	*Lomandra confertifolia*	Mat Rush	1, 2
LOMANDRACEAE	*Lomandra filiformis*		1, 2, 4
LOMANDRACEAE	*Lomandra glauca*	Pale Mat-rush	1, 4
LOMANDRACEAE	*Lomandra longifolia*	Spiny-headed Mat Rush	1, 2, 3, 4
LOMANDRACEAE	*Lomandra multiflora*	Many-flower Mat-rush	1, 4
ORCHIDACEAE	*Lyperanthus suaveolens*	Brown-beaks/Orchid	1
ZAMIACEAE	*Macrozamia flexuosa*		1
ASCLEPIADACEAE	*Marsdenia suaveolens*	Sweet-scented Doubah	1, 4
MYRTACEAE	*Melaleuca linariifolia*	Snow in Summer	4
MYRTACEAE	*Melaleuca nodosa*	Ball Honeymyrtle	4
MYRTACEAE	*Melaleuca quinquenervia*	Broad-leaf Paperbark	1, 2, 3, 4
MYRTACEAE	*Melaleuca sieberi*	Sieber's Paperbark	4
MYRTACEAE	*Melaleuca styphelioides*	Prickly-leaved Paperbark	1, 4
MYRTACEAE	*Melaleuca thymifolia*		4
ASTERACEAE	*Microseris lanceolata*		1, 4
ORCHIDACEAE	*Microtis oblonga*	Mignonette Orchid	4
ORCHIDACEAE	*Microtis rara*	Scented Onion Orchid	1
ORCHIDACEAE	*Microtis unifolia*	Common Onion Orchid	1
LOGANIACEAE	*Mitrasacme polymorpha*	Bishops mitre	1, 4
EPACRIDACEAE	*Monotoca eliptica*	Tree Broom-heath	1, 2, 4
EPACRIDACEAE	*Monotoca scoparia*		1, 2
MYOPORACEAE	*Myoporum acuminatum*	Boobialla	1, 4
OLEACEAE	*Notelaea ovata*	Mock Olive	1
OLACACEAE	*Olax stricta*		1, 4
ASTERACEAE	*Olearia sp.*	Daisy-bush	1
EUPHORBIACEAE	*Omalanthus populifolius*	Bleeding Heart	1, 2, 3, 4
ORCHIDACEAE	*Orthoceras strictum*	Bird's Mouth Orchid	4
ASTERACEAE	*Ozothamnus diosmifolium*	Everlasting	1, 2
BIGNONIACEAE	*Pandorea pandorana*	Wonga Wonga vine	1, 3, 4
APOCYNACEAE	*Parsonsia straminea*	Monkey Rope	1
POACEAE	*Paspalum paspalodes*	Salt Couch	1
IRIDACEAE	*Patersonia glabrata*		1, 3, 4
POACEAE	*Pennisetum clandestinum*	Kikuyu	1

Family	*Scientific Name*	Common Name	Record
POLYGONACEAE	*Persicaria decipiens*	Spotted Knotweed	1, 3
PROTEACEAE	*Persoonia lanceolata*	Lance-leaf Geebung	1, 2, 3, 4
PROTEACEAE	*Persoonia levis*	Smooth/Broad-leaved Geebung	1, 2, 4
RUTACEAE	*Philotheca salsolifolia*		1, 4
PHYLYDRACEAE	*Philydrum lanuginosum*	Frog Mouth	1, 4
POACEAE	*Phragmites australis*	Common Reed	1, 3
FABACEAE	*Phyllota phylicoides*		1, 4
THYMELAEACEAE	*Pimelea linifolia*	Granny's Bonnet/Slender Rice-flower	1, 2, 3, 4
PITTOSPORACEAE	*Pittosporum revolutum*	Rough-fruit Pittosporum	1
PITTOSPORACEAE	*Pittosporum undulatum*	Sweet Pittosporum	1, 3
POLYPODIACEAE	*Platycerium bifurcatum*	Elk Horn	1
FABACEAE	*Platylobium formosum*		1, 4
APIACEAE	*Platysace ericodes*	Heath Platysace	1, 2, 3, 4
APIACEAE	*Platysace linearifolia*	Carrot Tops	4
RUBIACEAE	*Pomax umbellata*	Umbel Plant	2, 4
EUPHORBIACEAE	*Poranthera corymbosa*		1, 4
EUPHORBIACEAE	*Poranthera microphylla*		1, 4
ORCHIDACEAE	*Prasophyllum elatum*	Tall Leek Orchid	1
LOBELIACEAE	*Pratia purpurascens*	Whiteroot	1, 3
LAMIACEAE	*Prostanthera densa#*	Cliff Mintbush	1
ACANTHACEAE	*Pseuderanthemum variabile*	Pastel Flower	3
DENNSTAEDTIACEAE	*Pteridium esculentum*	Bracken Fern	1, 2, 3
ORCHIDACEAE	*Pterostylis grandiflora*	Cobra Greenhood	1, 4
ORCHIDACEAE	*Pterostylis mutica*	Greenhood	1, 4
ORCHIDACEAE	*Pterostylis nutans*	Nodding Greenhood	1, 3, 4
FABACEAE	*Pultenaea myrtoides*	Bush Pea	1, 4
FABACEAE	*Pultenaea rosmarinifolia*	Bush Pea	1, 4
RESTIONACEAE	*Restio complanatus*	Cord Rush	4
RESTIONACEAE	*Restio tetraphyllus*	Tassel Cord-rush/Feather Plant	1, 3, 4
CHENOPODIACEAE	*Rhagodia candolleana*	Coastal Salt Bush	1
EUPHORBIACEAE	*Ricinocarpos pinifolius*	Wedding Bush	1, 2, 3, 4
ROSACEAE	*Rubus hillii*	Native Raspberry	1
STERCULIACEAE	*Rulingia prostrata##*		1
PRIMULACEAE	*Samolus repens*	Creeping Brookweed	1
CHENOPODIACEAE	*Sarcocornia quinqueflora*	Saltwort/Samphire	1, 3
GOODENIACEAE	*Scaevola calendulacea*	Scented Fan Flower	1, 2
GOODENIACEAE	*Scaevola ramosissima*	Snake Flower	1, 4
SCHIZAECEAE	*Schizaea dichtoma*	Branched Comb-fern	1
CYPERACEAE	*Schoenus apogon*	Fluke Bogrush	4
CYPERACEAE	*Schoenus brevifolius*		4
CYPERACEAE	*Schoenus ericetorum*		4
SELAGINELLACEAE	*Selaginella uliginosa*	Swamp selaginella	1, 3, 4
ASTERACEAE	*Senecio lautus*		4
SMILACACEAE	*Smilax australis*	Sasparilla, Prickly Smilax	1, 3
SMILACACEAE	*Smilax glyciphylla*	Lawer Vine	1, 4
SOLANACEAE	*Solanum mauritanum*	Wild Tobacco	1
SOLANACEAE	*Solanum nigrum*	Blackberry Nightshade	1
ANTHERICACEAE	*Sowerbaea juncea*	Vanilla Lily	1, 4
FABACEAE	*Sphaerolobium vimineum*		4
POACEAE	*Spinifex hirsutus*	Hairy Spinifex	1

Family	*Scientific Name*	Common Name	Record
LEMNACEAE	*Spirodela sp.*	Duck Weed	1
POACEAE	*Sporobolus virginicus*	Sand Couch	1
EPACRIDACEAE	*Sprengelia incarnata*		3, 4
EPACRIDACEAE	*Sprengelia sprengeloides*		4
STYLIDIACEAE	*Stylidium graminifolium*	Trigger Plant	4
LILIACEAE	*Stypandra caespitosa*	Flax Lily	1
CHENOPODIACEAE	*Suaeda australia*	Sea blight	1
FABACEAE	*Swainsonia sp.*		3
WINTERACEAE	*Tasmannia insipida*	Bush Pepper-bush	1
AIZOACEAE	*Tetragonia tetragonioides*	New Zealand Spinach	1
TREMANDRACEAE	*Tetratheca ericifolia*	Black-eyed Susan	1, 3, 4
TREMANDRACEAE	*Tetratheca juncea#*		1
TREMANDRACEAE	*Tetratheca thymifolia*	Black-eyed Susan	1, 2
ORCHIDACEAE	*Thelymitra ixioides var. ixioides*	Spotted Sun Orchid	1, 3, 4
POACEAE	*Themeda australis*	Kangaroo Grass	1, 2, 3, 4
ANTHERICACEAE	*Thysanotus tuberosus*	Common Fringe-lily	1, 4
APIACEAE	*Trachymene incisa*	Wild Parsnip	1, 3, 4
APIACEAE	*Trachymene straminea*	Wild Parsnip	1
LILIACEAE	*Tricoryne elatior*	Yellow Rush Lily	1, 2, 3, 4
JUNCAGINACEAE	*Triglochin procerum*		1
JUNCAGINACEAE	*Triglochin striata/procera*	Streaked Arrow Grass	1, 4
	Tripaeolum majus	Nasturtium	
TYPHACEAE	*Typha domingensis*	Cumbungi	1
TYPHACEAE	*Typha orientalis*	Cumbungi/Bull Rush	1, 3
MENYANTHACEAE	*Villarsia exaltata*	Yellow Marsh Flower	1, 3, 4
FABACEAE	*Viminaria juncea*	Golden Spray	4
VIOLACEAE	*Viola betonicifiolia*	Wild Top	1
CAMPANULACEAE	*Wahlenbergia communis*	Blue Bell	1, 2, 4
CAMPANULACEAE	*Wahlenbergia gracilis*	Native Bluebell	4
CAMPANULACEAE	*Wahlenbergia stricta*	Blue Bell	1, 4
XANTHORRHOEACEAE	*Xanthorrhoea australis*	Large Grass Tree	1
XANTHORRHOEACEAE	*Xanthorrhoea media*	Grass Tree	4
XANTHORRHOEACEAE	*Xanthorrhoea minor*	Small Grass tree	1, 3, 4
XANTHORRHOEACEAE	*Xanthorrhoea resinosa*	Grass Tree	4
APIACEAE	*Xanthosia pilosa*	Woolly Xanthosia	1, 3
XYRIDACEAE	*Xyris complanata*	Feathered Yellow-eye	4
XYRIDACEAE	*Xyris juncea*	Dwarf Yellow-eye	4
RUTACEAE	*Zieria laevigata*	Angulur Zieria	1, 2, 3, 4

1 = NPWS Wildlife Atlas Database
2= Eckersley, J. (2000) Flora and Fauna Listing Mambo Wetland
3 = Port Stephens Council Flora Survey, 2003
4 = Mc Nair, D. (1985) Flora of Port Stephens and Myall Lakes Region, NSW

= Endangered
= Vulnerable

Appendix 2 – Fauna Species List

Mambo Wetland Fauna Species List		
Scientific Name	**Common Name**	**Record**
AMPHIBIANS		
Adelotus brevis	Tusked Frog	1
Crinia signifera	Common Eastern Froglet	1
Limnodynastes dumerilii	Eastern Banjo Frog	1
Limnodynastes ornatus	Ornate Burrowing Frog	1
Limnodynastes peronii	Brown-striped frog	1
Limnodynastes tasmaniensis	Spotted Grass Frog	1
Litoria caerulea	Green Tree Frog	1
Litoria fallax	Eastern Dwarf Tree Frog	1
Litoria latopalmata	Brown Palmed Frog	1
Litoria lesueurii	Lesueur's Frog	1
Litoria peronii	Peron's Tree Frog	1
Litoria phyllochroa	Leaf Green Tree Frog	1
Litoria tyleri	Tyler's Tree Frog	1
Litoria verreauxii	Whistling Tree Frog	1
Paracrinia haswelli	Haswell's Frog	1
Pseudophhryne coriacea	Red-backed Toadlet	1
Uperoleia laevigata	Smooth Toadlet	1
Uperoleia fusca	Dusky Toadlet	1
REPTILES		
Amphibolurus muricatus	Jacky Lizard	1
Cryptoblepharus virgatus	Fence Skink	1
Ctenotus robusta	Striped Skink	1
Ctenotus taeniolatus	Copper-tailed Skink	1
Cyclodomorphus michaeli	Oak Skink	1
Demansia psammophis	Yellow-faced Whip Snake	1
Dendrelaphis punctulatus	Common Tree Snake	1
Diplodactylus vittatus	Wood Gecko	1
Egernia major	Land Mullet	2
Eulamprus quoyii	Eastern Water skink	1
Lampropholis guichenoti	Garden Skink	1
Lialis burtonis	Burton's Snake Lizard	1
Morelia spilota ssp. spilota	Diamond Python	1
Oedura lesueurii	Lesueur's Velvet Gecko	1
Phyllurus platurus	Southern Leaf-tailed Gecko	1
Physiganathus lesueurii	Eastern Water Dragon	1
Pogona babata	Bearded Dragon	1
Pseudechis porphyriacus	Red-bellied Black Snake	1
Pseudonaja textilis	Eastern Brown Snake	1
Ramphotyphlops nigrescens	Blind Snake	1
Saiphos equalis	Three-toed Skink	1
Tiliqua scincoides	Eastern Blue Tongue Lizard	1
Varanus various	Lace Monitor	1

Scientific Name	Common Name	Record
MAMMALS		
Antechinus flavipes	Yellow-footed Antechinus	1
Antechinus stuartii	Brown Antichinus	1
Chalinobus gouldii	Gould's Wattled Bat	1, 2
Chalinobus morio	Chocolate Wattled Bat	1
Falssitrellus papuensis	Golden-tipped Bat	1
Hydromys chrysogaster	Water Rat	1
Isoodon macrourus	Northern Brown Bandicoot	1
Macropus giganteus	Eastern Grey Kangaroo	1
Macropus rufogriseus	Red-necked Wallaby	1
Mormopterus gracilicaudatus	Eastern Chestnut Mouse	1
Mormopterus loriae	Little Free-tail Bat	1
Mormopterus novaehollandiae	New Holland Mouse	1
Nyctophilus geoffroyi	Lesser Long-eared Bat	1
Nyctophilus gouldi	Gould's Long-eared Bat	1
Perameles nasuta	Long-nosed Bandicoot	1
Petaurus breviceps	Sugar Glider	1
Phascolarctos cinereus	Koala	1,3
Pseudocheirus peregrinus	Ringtail Possum	1
Pteropus poliocephalus	Grey-headed Flying-fox	1, 2
Pteropus scapulatus	Little Red Flying-fox	1
Rattus lutreolus	Swamp Rat	1
Rhinolophus megaphyllus	Eastern Horseshoe-bat	1
Scotorepens orion	Eastern Broad-nosed Bat	1, 2
Scotorepens sp.	Broad-nosed Bat	1, 2
Sminthopsis murina	Common Dunnart	1
Tadarida australis	White-striped Mastiff-bat	1
Trichosurus vulpecula	Brushtail Possum	1
Vespadelus regulus	King River Eptesicus	1
Vespadelus vulturnus	Little Forest Bat	1, 2
Wallabia bicolor	Swamp Wallaby	1
BIRDS		
Acanthiza apicalis	Brown Thornbill	2
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	1, 2
Acanthiza lineata	Striated Thornbill	1
Acanthiza nana	Yellow Thornbill	1, 2
Acanthorhynchus tenuirostris	Eastern Spinebill	1, 2
Accipiter novaehhollandiae	Grey Goshawk	1, 2
Acrocephalus stentoreus	Clamorous Reed-warbler	2
Alisterus scapularis	King Parrot	1
Anas superciliosa	Pacific Black Duck	1, 2
Anthochaera carunculata	Red Wattlebird	1
Anthochaera chrysoptera	Little Wattlebird	1
Anthus novaeseelandiae	Richards Pipit	2

Scientific Name	Common Name	Record
Anus castanea	Chestnut Teal	2
Anus gracilis	Grey Teal	2
Ardea alba	Great Egret	2
Ardea intermedia	Intermediate Egret	2
Ardea novaehollandiae	White-faced Heron	1, 2
Ardea sacra	Eastern Reef Egret	1
Artamus cyanopterus	Dusky Woodswallow	1, 2
Artamus leucorhynchus	White-breasted Wood Swallow	1, 2
Avicceda subcristata	Pacific Baza	1, 2
Cacatua galeirita	Sulphur-crested Cockatoo	1
Cacatua roseicapilla	Galah	1, 2
Cacatua tennuirostris	Little Corella	2
Calyptorhynchus funereus	Yellow-tailed Black Cockatoo	1, 2
Calyptorhynchus lathami	Glossy Black Cockatoo	2
Cecropis ariel	Fairy Martin	1
Cecropus nigricans	Tree Martin	1, 2
Centropus phasianinus	Pheasant Coucal	1, 2
Chenonetta jubata	Maned Duck	1, 2
Chlidonias hybrida	Whiskered Tern	1
Chrysococcyx lucidus	Shining Bronze- Cuckoo	1, 2
Chrysococcyx basalis	Horsefield's Bronze Cuckoo	1,2
Circus approximans	Swamp Harrier	2
Climacteris leucophaea	White-throated Treecreeper	1, 2
Colluricincla harmonica	Grey Shrike-thrush	1, 2
Columba livia	Feral Pigeon	1
Coracina novaehollandiae	Black-faced Cuckoo Shrike	2
Corcorax melanorhamphos	White-winged Chough	1
Corvus coronoides	Australian Raven	2
Corvus orru	Torressian Crow	1
Coturnix pectoralis	Stubble Quail	1
Cracticus nigrogularis	Pied Butcherbird	1, 2
Cracticus torquatus	Grey Butcherbird	1, 2
Cuculus pyrrhophanus	Fan-tailed Cuckoo	1, 2
Dacelo novaeguineae	Kookaburra	1, 2
Daphoenositta chrysoptera	Varied Sitella	2
Dicaeum hirundinaceum	Mistletoebird	1, 2
Dicurus megarhynchus	Spangled Drongo	1, 2
Egretta alba	Great Egret	1, 2
Elanus axillaris	Black-shouldered Kite	2
Entomyzon cyanotis	Blue-faced Honeyeater	2
Eopsaltria australis	Eastern Yellow Robin	1, 2
Eudynamys scolopacea	Common Koel	2
Eurystomus orientalis	Dollarbird	1, 2
Falssitrellus tasmaniensis	Eastern Falsistrelle	1

Scientific Name	Common Name	Record
Fulica atra	Eurasian Coot	1
Gallinula tenebrosa	Dusky Moorhen	1, 2
Geopelia humeralis	Bar-shouldered Dove	2
Geopelia placida	Peaceful Dove	1, 2
Geophaps iophotes	Crested Pigeon	2
Gerygone levigaster	Mangrove Warbler	1
Gerygone olevacea	White-throated Gerygone	1, 2
Glossopsitta concina	Musk Lorikeet	2
Glossopsitta pusilla	Little Lorikeet	1
Grallina cyanoleuca	Magpie-Lark/Pied Mudlark	1, 2
Gymnorhina tibicen	Australian Magpie	2
Halcyon sancta	Sacred Kingfisher	1, 2
Haliaeetus leucogaster	White-bellied Sea-eagle	1, 2
Haliastur spenurus	Whistling Kite	1, 2
Hirundo neoxena	Welcome Swallow	1, 2
Lalage suerii	White-winged Triller	1, 2
Larus novaechollandiae	Silver Gull	1, 2
Lichenostomus chrysops	Yellow-faced Honeyeater	1, 2
Lichenostomus leucotis	White-eared Honeyeater	1
Lichmera indistincta	Brown Honeyeater	2
Malurus cyaneus	Superb Fairy Wren	1, 2
Malurus lamberti	Variegated Fairy-wren	1, 2
Manorina melanocephala	Noisy Miner	1, 2
Meliphaga lewinii	Lewin’s Honeyeater	1, 2
Melithreptus lunatus	White-naped Honeyeater	1, 2
Merops ornatus	Rainbow Bee-eater	1, 2
Monarcha trivirgatus	Black-faced Monarch	2
Monarchha trivirgatus	Spectacled Monarch	1
Myiagra cyanoleuca	Satin Flycatcher	1
Myiagra inquieta	Restless Flycatcher	1, 2
Myiagra rubecula	Leaden Flycatcher	1, 2
Myzomela sanguinolenta	Scarlet Honeyeater	1, 2
Neochmia temporalis	Red-browed Finch	1, 2
Ninox novaeseelandiae	Southern Boobook Owl	1
Ninox strenua	Powerful Owl	2
Numenius madagascariensis	Eastern Curlew	1
Nycticorax caledonicus	Nankeen Night Heron	2
Oriolus sagittatus	Olive-backed Oriole	1, 2
Pachycephala pectoralis	Golden Whistler	1, 2
Pachycephala rufiventris	Rufous Whistler	1, 2
Pardalotus punctatus	Spotted Pardalote	1, 2
Passer domesticus	House Sparrow	1
Petroica rosea	Rose Robin	1, 2
Phalacrocorax carbo	Great Cormorant	1

Scientific Name	Common Name	Record
Phalacrocorax melanoleucos	Little Pied Cormorant	1
Phalacrocorax sulcirostris	Little Black Cormorant	1
Phalacrocorax varius	Pied Cormorant	1
Philemon citreogularis	Little Friarbird	1
Philemon corniculatus	Noisy Friarbird	1
Phylidonyris nigra	White-cheeked Honeyeater	1, 2
Phylidonyris novaehollandiae	New Holland Honeyeater	1
Platalea flavipes	Royal Spoonbill	1, 2
Platycercus eximius	Eastern Rosella	1, 2
Platycerus elegans	Crimson Rosella	1
Podargus strigoides	Tawny Frogmouth	1, 2
Porphyrio porphyrio	Purple Swamphen	1, 2
Psephotus haematonotus	Red Rumped Parrot	1
Psophodes olivaceus	Eastern Whipbird	1
Ptilonorhynchus violaceus	Satin Bowerbird	1
Rhipidura fuliginosa	Grey Fantail	2
Rhipidura leucophrys	Willie Wagtail	1, 2
Rhipidura rufifrons	Rufous Fantail	1, 2
Scythrops novaehollandiae	Channel-billed Cuckoo	2
Sericornis frontalis	White-browed Scrubwren	1, 2
Smicrornis brevirostris	Weebill	1
Specotherus viridus	Fig Bird	2
Sterna bergii	Crested Tern	1
Strepera graculina	Pied Currawong	1, 2
Streptopelia chinensis	Spotted Turtle Dove	1, 2
Taeniopygia bichenovii	Double-barred Finch	2
Threskiornis molucca	Sacred Ibis	2
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	1, 2
Trichoglossus haematodus	Rainbow Lorikeet	1, 2
Tyto longimebris	Eastern Grass Owl	1
Vanellus miles	Masked Lapwing	1
Zosterops lateralis	Silvereye	1, 2

1 = NPWS Wildlife Atlas

2 = Mambo-Wanda Reserve Committee and Tomaree Bird Watchers

3 = Native Animal Trust Fund

Appendix 3 - Minutes of Public Meeting 16th June, 2003

Summary of Issues

1. Litter from Kingfisher Reserve
2. Environmental education in schools
3. Erosion of Mambo Creek
4. Declining beach area near Salamander Bay
5. Maintenance of silt traps and other infrastructure\
6. Sediment traps in Spinnaker Way
7. Future subdivisions
8. Stormwater issues in Salamander Way subdivision
9. Runoff from Salamander Bay shopping centre
10. Boundary issues
11. Educational signage
12. Stormwater education
13. Urban stormwater
14. Fire management
15. Public access
16. Closing off Foreshore Drive
17. LEP information
18. Areas of Aboriginal significance
19. Invasive weeds
20. Habitat decline and fragmentation
21. Introduced animals
22. Indian mynas
23. Zoning of land and future proposals

Issues Raised

1. Kingfisher Reserve, Spinnaker Way. Large amount of litter entering wetland through stormwater pipes. Litter traps here a possible solution.

2. Importance of education in schools to raise environmental awareness of the youth. An idea was put forward to have a boardwalk through the wetland for educational purposes for teachers to take their students through. Local daycare centre also interested in an area in the Wetland suitable for educational excursions.

3. On the western side of Mambo Creek (at the entrance to Salamander Bay), the bank is eroded due to the impacts of fishing and other recreational activities. Erosion is also evident at Little Mambo Creek.

4. Sand replenishment of Salamander Bay has been blocked by development, particularly of the Anchorage Resort. This is particularly evident on the eastern side of Mambo Creek. This is resulting in the gradual loss of the beach, and therefore access along the foreshore. Perhaps this should be a matter to be heard by the estuary management committee.

5. It was brought up that although there are many silt traps and other stormwater devices in the area, these are not being maintained regularly and therefore aren't working as efficiently. Regular maintenance of this infrastructure is required in order for it to work effectively.

6. It was raised that silt traps or some other sediment trapping device are necessary on Spinnaker Way. This area has a high sediment loading, and therefore impacts on water quality in Mambo Wetland.

7. Concern was raised in regards to the subdivision of existing lots into smaller blocks. This would put greater pressure on the environment of Mambo Wetland due to impacts such as urban runoff.

8. It was identified that stormwater infiltration structures may be required on Salamander Way due to new development.

9. Concern was raised about the fate of runoff coming from Salamander Bay shopping centre.

10. A range of issues occurring at the boundary to the wetland were identified. These included garden waste dumping, exotic garden species escaping into reserve, mown areas extending into reserve, litter and fire management.

11. Improving signage around the reserve was identified as a possibility for improving the awareness of the community on the importance of Mambo Wetland and how to look after it. Some issues to be addressed with the signage may include dogs (their impact on wildlife, and the effect of dog faeces on water quality), litter, motorbikes, regulation of bylaws.

12. Some residents were interested in stormwater education to find out more about how their activities may be impacting on the wetland. Use of fertilisers on the garden was an example. This raised the need to develop a fact sheet/pamphlet which educates residents on how they can make a few small changes to reduce their impact on stormwater.

13. Urban stormwater was an important issue raised, particularly with the increase in development over the last decade. The major impacts of stormwater on the wetland were identified as water pollution and changes to the natural hydrology. The suggestion was made to encourage rainwater tanks in the catchment in order to reduce the volume of stormwater runoff entering the wetland. Artificial wetlands, silt traps, litter traps and other similar structures were suggested to reduce the impacts of stormwater on Mambo Wetland. Education of residents of the entire catchment may also be an effective way of reducing stormwater pollutants. Many of the new housing developments are now adopting water sensitive urban design approaches. This should be continued for all future developments, and technology improved as new information becomes available.

14. The management of fire within the reserve was raised by several individuals, and is a major issue that needs to be addressed. There is a need to minimise the risk of a fire occurring in order to protect people and property that may be affected by a fire in the reserve. It is also important to prevent frequent fires as this is detrimental to native flora and fauna (some species require several years to recover after fire and will be wiped out should the fires become too frequent). If a fire does occur, there must be suitable fire trails such that the fire fighters can safely access the reserve to fight the fire. John Eckersley has liased with the fire department, Aboriginal Land Council and PSC regarding fire trails within the reserve. The proposed fire trails are soon to be approved.
    It was raised that there is currently no access for fire crews through Compass Close, Mariner Crescent, Worimi Drive and Admiral Close. These should be looked at in the fire trail proposals. Gates should be put on fire trails to exclude the access of other unauthorised vehicles. The key for these gates may be held at an easily accessible location (or several locations) such that fire fighters can gain access in emergencies.

Piles of removed weeds such as Lantana and Bitou bush were identified as a fire hazard. When these high piles are placed at the base of trees, they act as a wick, raising the fire up into the tree canopy. Community groups carrying out weed removal have identified this risk and are now making sure that they mulch the piles down more, and place them away from trees where possible.

Several residents raised the issue of fire reduction burning and the need for this in Mambo Wetland. This issue was not resolved, but will be looked into and addressed in the management plan. Residents were also confused as to who is responsible for the maintenance of fire buffer zones at the boundary of houses and the reserve. This is also an issue that will be looked into, and residents will be informed of the outcome.

15. The issue of public access was identified. There is a need to manage access into the reserve (walkers, motorbikes and four wheel drives) such that the community can enjoy the reserve, while still conserving its natural values. In this discussion, the idea of closing off foreshore drive was raised. This road has separated the wetland from Salamander Bay, hence impeding the natural flushing of the mangroves through Mambo Creek. If Foreshore Drive is closed, however, there may be problems with access in the event of a fire.

16. If the proposal for the closing of Foreshore Drive was accepted, then the community expressed the need for providing infrastructure for walking and bicycle access. Even if Foreshore Drive remains open, there is the need to improve roadside access as it is currently very dangerous to walk along this road.

17. Some residents expressed interest in finding out more information regarding the land classification zones in the area. For those interested, Council are happy to send out information from the LEP.

18. Representatives from the Aboriginal community need to be consulted in order to identify any sites of cultural significance in Mambo Wetland.

19. Invasive weeds is another important issue, having impacts on native flora and fauna, and the overall biodiversity of the reserve. There are a number of weeds present in Mambo Wetland, including aquatic and terrestrial weeds. Some of these are the result of exotic plants escaping from domestic gardens. There is a need to control further encroachment of these weeds in order to protect the remaining vegetation, and to maintain suitable habitat for fauna.

20. Mambo wetland has experienced habitat decline and fragmentation with the encroachment of development. As the reserve becomes smaller, the ability of native flora and fauna to survive becomes less. Residents noted that they have seen a decline in bird species and diversity of fauna as the reserve has become smaller and surrounded by development. Native fauna need a certain area to maintain a viable population. While lost habitat cannot be reclaimed, the area remaining can be maintained as high quality habitat, or regenerated into this where possible.

21. There are a number of introduced animals within Mambo Wetland that pose a threat to the natural biodiversity. These include Gambusia (Mosquito Fish), feral ducks, foxes, rabbits, feral cats and dogs and roaming domestic pets. Residents also expressed concern about the large populations of mosquitoes which cause a public health risk as well as annoyance.

Residents noted that there are many cats that are roaming free in the area, and these are attacking native birds in the wetland. Even those cats wearing bells are still able to catch the birds. A solution to this may be to educate residents on the impacts their pets have on native wildlife, and how they can minimise this impact.

Concerns were raised about the potential for Indian Myna birds to overtake the native bird species of the wetland. Research will need to be undertaken to look into a control program for these birds to protect the native wildlife. One suggestion was to look into a trapping program to reduce the population of Indian Mynas.

22. A parcel of land at the end of Worimi Drive was discussed. There was confusion as to the zoning of the land, as well as the future proposals for this land. Jason Linnane (PSC) confirmed that this land is currently operational land, however a proposal has been lodged to change this to community land under the LGA 1993.

23. Concerns were also raised as to the future of a parcel of land at the corner of Port Stephens and Foreshore Drives, owned by the Department of Education. Correspondence with the Dept. indicates that they have no plans to develop this land and would like a land swap with Port Stephens Council.

Appendix 4 – Key Threatening Processes for Mambo Wetland: Final Determinations

KEY THREATENING PROCESS: Competition and grazing by the feral European rabbit
NSW Scientific Committee - final determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Competition and grazing by the feral European Rabbit Oryctolagus cuniculus (L.) as a Key Threatening Process on Schedule 3 of the Act. Listing of Key Threatening Processes is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. The European Rabbit Oryctolagus cuniculus was successfully introduced into Australia in 1858. It has since spread broadly across the southern two thirds of the continent, and its area of occupancy is now approximately 4.5 million square kilometres (Myers et al. 1989).

2. Feral rabbits occupy a wide range of habitats, including native and modified grasslands, woodland, heath and forest, and can achieve high densities in some agricultural and suburban areas. Unlike the domesticated rabbit, which is not the subject of this determination, feral rabbits exhibit minimal or no dependence on humans to meet their ecological requirements.

3. There is evidence that feral rabbits impact negatively on indigenous species via competition for resources, alteration of the structure and composition of vegetation, and land degradation. Competition and land degradation by feral rabbits is listed as a Key Threatening Process on Schedule 3 of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

4. Feral rabbits are grazers that prefer green grass and herbage. They may also feed on seeds and browse and, during drought, the bark and roots of shrubs. Several indigenous species overlap in diet with the feral rabbit, and are impacted negatively by competition for food with the feral rabbit. Threatened species that suffer in dietary competition with the feral rabbit include the Yellow-footed Rock-wallaby Petrogale xanthopus, Brush-tailed Rock-wallaby Petrogale penicillata and Southern Hairy-nosed Wombat Lasiorhinus latifrons (Dawson & Ellis 1979, 1984; St John 1989; Short & Milkovits 1990). The Plains Wanderer Pedionomus torquatus and Malleefowl Leipoa ocellata also appear to be adversely affected by the feral rabbit, through competition for food and/or by alteration and reduction of suitable habitat (Baker-Gabb 1990; Garnett 1992).

5. Grazing by feral rabbits reduces survival and recruitment of several species of threatened plants. These include Acacia carneorum, Grevillea kennedyana, Cynanchum elegans, Thesium australe and Lepidium hyssopifolium (Cropper 1987; Auld 1990, 1993; Griffith 1992; Matthes & Nash 1993). Grazing by feral rabbits appears also to have marked effects on the structure and composition of vegetation communities in many areas (Williams et al. 1995), and a number of Endangered Ecological Communities including the Acacia loderi Endangered Ecological Community.

6. Grazing by feral rabbits could cause species, populations or ecological communities that are not threatened to become threatened. A number of long-lived tree and shrub species have their recruitment prevented or severely limited by rabbit grazing in arid and semi-arid Australia, including NSW (Crisp and Lange 1976; Lange and Graham 1983; Chesterfield and Parsons 1985; Auld 1990; 1993; 1995a, 1995b; Woodell 1990; Pickard 1991; Tiver and Andrew 1997, Auld and Denham 2001). Continued rabbit impacts could cause some of these species (or populations of them) to become threatened, while where they are community dominants the ecological community may become threatened. Examples include Acacia spp; Hakea spp., Callitris gracilis, and communities of belah/rosewood (Casuarina pauper/Alectryon olefolius) and western Myall, Acacia pendula.

7. By removing above-ground and below-ground vegetation, feral rabbits contribute to erosion and loss of topsoil by wind and rain. This form of land degradation reduces the chance of successful establishment of indigenous plants, and increases the susceptibility of many indigenous vertebrates to predation from feral predators (Morton 1990; Dickman 1993).

8. Feral rabbits are eaten by introduced predators such as red foxes Vulpes vulpes and feral cats Felis catus, and can maintain populations of these species at artificially high levels. Dietary switching of these predators from rabbits to indigenous species can occur following declines in rabbit populations, such as those caused by rabbit calicivirus disease, causing 'hyper-predation' impacts on indigenous species (Dickman 1996; Newsome et al. 1997). A Threat Abatement Plan to manage Competition and grazing by the Feral European Rabbit Oryctolagus cuniculus (L.) should therefore be integrated with management of introduced predators.

9. In view of points 3, 4, 5, 6, 7 and 8 above, the Scientific Committee is of the opinion that Competition and grazing by the feral European Rabbit Oryctolagus cuniculus adversely affects two or more threatened species, populations or ecological communities or could cause species, populations or ecological communities that are not threatened to become threatened.
Proposed Gazettal date: 10/05/02
Exhibition period: 10/05/02 – 14/06/02

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KEY THREATENING PROCESS: Invasion of native plant communities by bitou bush and boneseed
NSW Scientific Committee - final determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the Invasion of Native Plant Communities by *Chrysanthemoides monilifera* as a KEY THREATENING PROCESS on Schedule 3 of the Act. Listing of Key Threatening Processes is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. *Chrysanthemoides monilifera* is a South African species of which two subspecies occur in Australia - ssp. monilifera - boneseed, and ssp. rotundata - bitou bush. Both subspecies invade and displace native plant communities.

2. *Chrysanthemoides monilifera ssp. rotundata* was first recorded in New South Wales from near Newcastle in 1908, and was extensively planted for dune stabilisation between 1946 and 1968. It has spread rapidly and is now found on 90% of the sandy coast of New South Wales, covering an area in excess of 70,000 ha.

3. Vigorous growth, prolific seed production and effective seed dispersal of both subspecies enable them to compete strongly with, or in some places eliminate, native vegetation.

4. *Chrysanthemoides monilifera* is currently declared a noxious weed in coastal Local Government Areas where it occurs in New South Wales.

5. The dense monoculture of *Chrysanthemoides monilifera* which develops after invasion threatens local vegetation at all sites which are affected. This may result in local and regional declines of many plant species and communities, possibly to the extent that they become endangered. The changed structure of the habitat may adversely impact on both native vertebrate and invertebrate fauna and may favour the prolification of non-indigenous species.

6. Invasion by *Chrysanthemoides monilifera* is an identified threat to a number of species and communities listed on Schedule 1 of the Threatened Species Conservation Act, including *Zieria prostrata, Chamaesyce psammogeton, Acacia terminalis subsp. terminalis* and Eastern Suburbs Banksia Scrub. The ability of *Chrysanthemoides* to become the overwhelming dominant in invaded ecological communities threatens all communities within the area of potential distribution of both subspecies of *Chrysanthemoides monilifera*. In the case of ssp. *rotundata*, communities at risk include dune grasslands and heathland, heathlands on headlands, scrub sclerophyll woodland and forest, and, littoral rainforest. Subspecies monilifera is a threat to a range of woodlands and forest. Many species in the threatened communities would themselves be threatened in consequence. This may include the following threatened taxa; Eastern Bristlebird, *Dasyornis brachypterus*; Little Tern, *Sterna albifrons* and Beach Stone-curlew, *Esacus neglectus*.

In view of 2, 3, 4, 5 and 6 above the Scientific Committee is of the opinion that the Invasion of Native Plant Communities by *Chrysanthemoides monilifera* adversely affects two or more threatened species or ecological communities and it could cause species that are not threatened to become threatened.

KEY THREATENING PROCESS: **Predation by feral cats**
NSW Scientific Committee - final determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Predation by the Feral Cat *Felis catus* (Linnaeus, 1758) as a KEY THREATENING PROCESS on Schedule 3 of the Act. Listing of Key Threatening Processes is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. The Cat *Felis catus* (Linnaeus, 1758) is a common but elusive predator that occurs throughout Australia and on many offshore islands. It was introduced to Australia with the First Fleet in 1788, but may have arrived prior to this on Indonesian trading vessels or European ships of exploration. Cats occur in virtually all terrestrial habitats in Australia, and the main determinants of local population size appear to be the availability of food and shelters.

2. Cats may be categorised as domestic, stray or feral. Domestic cats are pet or house cats living with people; their ecological requirements are intentionally provided by humans. Stray cats rely only partly on humans for provision of their ecological requirements, and include animals in urban fringe situations, dumped animals, and cats kept on farms for rodent control. Feral cats are free-living; they have minimal or no reliance on humans for their ecological requirements, and survive and reproduce in self-perpetuating populations. Individual cats can shift between categories in their lifetimes. This determination concerns only Feral Cats.

3. The Feral Cat is carnivorous and capable of killing vertebrates up to 2-3kg. Preference is shown for mammals weighing less that 220g. and birds less than 200g. but reptiles, amphibians and invertebrates are also eaten. Carrion and other scavenged material is taken if live prey is not available.

4. Predation by Feral Cats has been implicated in the extinction and decline of many species of mammals and birds on islands around Australia and in other parts of the world, and in the early extinction of up to seven species of small mammals on the Australian mainland.

5. In New South Wales, predation by Feral Cats has been linked to the disappearance by 1857, of 13 species of mammals and 4 species of birds from the Western Division. Current impacts on native species are most likely in modified, fragmented environments and where alternative prey such as Rabbits or House Mice fluctuate in abundance.

6. Based on a rank-scoring system that predicts the susceptibility of native vertebrate species to predation from Feral Cats (Dickman 1996), several Endangered and Vulnerable species in New South Wales are currently threatened, including the Hastings River Mouse *Pseudomys oralis*, Sandy Inland Mouse *Pseudomys hermannsburgensis*, Pilliga Mouse *Pseudomys pilligaensis*, Bolam's Mouse *Pseudomys bolami*, Forrest's Mouse *Leggadina forresti*, Mountain Pygmy-possum *Burramys parvus*, Little Tern *Sterna albifrons*, Grey Grasswren *Amytornis barbatus*, Striated Grasswren *Amytornis striatus* and the lizard *Aprasia aurita*. Larger species such as Southern Brown Bandicoots *Isoodon obesulus* and Brush-tailed Rock Wallabies *Petrogale penicillata* may also be at risk locally or when other prey is scarce.

7. Many other native species are potentially at risk of becoming threatened as a result of Cat predation. Small mammals such as rodents, dasyurids, burramyids and ground-nesting birds are at particular risk.

In view of 3, 4, 5, 6 and 7 above, the Scientific Committee is of the opinion that Predation by the Feral Cat adversely affects more than two threatened species and could cause species that are not threatened to become threatened, and is therefore eligible for listing as a Key Threatening Process under the Threatened Species Conservation Act.

Reference:

Dickman, C.R. (1996) Overview of the impacts of Feral Cats on Australian native fauna – Australian Nature Conservation Agency: Canberra

KEY THREATENING PROCESS: Predation by the plague minnow (*Gambusia holbrooki*)
NSW Scientific Committee - final determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Predation by *Gambusia holbrooki* (Plague Minnow) as a KEY THREATENING PROCESS on Schedule 3 of the Act. Listing of Key Threatening Processes is provided for by Division 2 Part 2 of the Act.

The Scientific Committee has found that:

1. *Gambusia holbrooki* Girard, 1859 (previously known as *Gambusia affinis*) (Plague Minnow, also known as Mosquito Fish) is a small freshwater fish originally introduced into Australia in the 1920s. The fish was imported as an aquarium fish but some were released into creeks around Sydney, Melbourne and Brisbane.

2. During the Second World War a government sponsored campaign was initiated to spread *Gambusia holbrooki* into as many east coast waterways as possible, as a control agent for mosquitoes.

3. *Gambusia holbrooki* is an aggressive and voracious predator. Overseas research has documented its impact on fish, invertebrates and frogs. (Grubb, J.C. 1972. American Midland Naturalist *88*, 102-8; Hurlbert, S.H., Zedler, J. & Fairbanks, D. 1972. Science 175, 639-41)

4. Recent research has documented that *Gambusia holbrooki* preys upon eggs and tadpoles of the Green and Golden Bell Frog, *Litoria aurea* (Morgan, L.A. & Buttermer, W.A. 1996. *Australian Zoologist* 30, 143-149, White, A.W. & Pyke, G.H. 1998 unpublished manuscript submitted to *Australian Zoologist*).

5. Other studies have demonstrated that *Gambusia* also preys upon *Litoria dentata* (Morgan & Buttermer *op.cit*), *Litoria lesueuri* (White & Pyke, *op.cit*) and *Limnodynastes peronii* (Webb, C. & Joss, J. 1997. *Australian Zoologist 30*, 316-26).

6. Presence of *Gambusia holbrooki* has been linked to the decline of *Litoria aurea*, the New England Bell Frog *Litoria castanea*, Southern Bell Frog *Litoria raniformis*, and the Southern Tablelands Bell Frog (*Litoria sp.*)

7. Breeding by *Litoria aurea* is almost completely restricted to water bodies lacking *Gambusia holbrooki.*

8. In view of 3, 4, 5, 6 above the Scientific Committee is of the opinion that Predation by *Gambusia holbrooki* is a serious threat to the survival of *Litoria aurea* and *Litoria castanea*, both species listed as threatened under the Threatened Species Conservation Act, and to other species of frog, and that predation by *Gambusia holbrooki* is therefore eligible to be listed as a key threatening process because it adversely affects two or more threatened species and it could cause species that are not threatened to become threatened.

Appendix 5 - LGA guidelines for categorisation of community land

LOCAL GOVERNMENT (GENERAL) REGULATION 1999 - SECT 13

13 Guidelines for categorisation of land as an area of cultural significance
Land should be categorised as an area of cultural significance under section 36 (4) of the Act if the land is:

(a) an area of Aboriginal significance, because the land:

(i) has been declared an Aboriginal place under section 84 of the *National Parks and Wildlife Act 1974* , or

(ii) whether or not in an undisturbed state, is significant to Aboriginal people in terms of their traditional or contemporary cultures, or

(iii) is of significance or interest because of Aboriginal associations, or

(iv) displays physical evidence of Aboriginal occupation (for example, items or artifacts such as stone tools, weapons, engraving sites, sacred trees, sharpening grooves or other deposits, and objects or materials that relate to the settlement of the land or place), or

(v) is associated with Aboriginal stories, or

(vi) contains heritage items dating after European settlement that help to explain the relationship between Aboriginal people and later settlers, or

(b) an area of aesthetic significance, by virtue of:

(i) having strong visual or sensory appeal or cohesion, or

(ii) including a significant landmark, or

(iii) having creative or technical qualities, such as architectural excellence, or

(c) an area of archaeological significance, because the area contains:

(i) evidence of past human activity (for example, below-ground features such as building foundations, occupation deposits, features or artifacts or above-ground features such as buildings, works, industrial structures, and relics, whether intact or ruined), or

(ii) any other deposit, object or material that relates to the settlement of the land, or

(d) an area of historical significance, because of the importance of an association or position of the land in the evolving pattern of Australian cultural history, or

(e) an area of technical or research significance, because of the area's contribution to an understanding of Australia's cultural history or environment, or

(f) an area of social significance, because of the area's association with Aboriginal life after 1788 or the area's association with a contemporary community for social, spiritual or other reasons.

LOCAL GOVERNMENT (GENERAL) REGULATION 1999 - SECT 10
10 Guidelines for categorisation of land as a natural area
Land should be categorised as a natural area under section 36 (4) of the Act if the land, whether or not in an undisturbed state, possesses a significant geological feature, geomorphological feature, landform, representative system or other natural feature or attribute that would be sufficient to further categorise the land as bushland, wetland, escarpment, watercourse or foreshore under section 36 (5) of the Act.

LOCAL GOVERNMENT (GENERAL) REGULATION 1999 - SECT 19

19 Guidelines for categorisation of land as foreshore
Land that is categorised as a natural area should be further categorised as foreshore under section 36 (5) of the Act if the land is situated on the water's edge and forms a transition zone between the aquatic and terrestrial environment.

LOCAL GOVERNMENT (GENERAL) REGULATION 1999 - SECT 15
15 Guidelines for categorisation of land as bushland

(1) Land that is categorised as a natural area should be further categorised as bushland under section 36 (5) of the Act if the land contains primarily native vegetation and that vegetation:

(a) is the natural vegetation or a remainder of the natural vegetation of the land, or

(b) although not the natural vegetation of the land, is still representative of the structure or floristics, or structure and floristics, of the natural vegetation in the locality.

(2) Such land includes:

(a) bushland that is mostly undisturbed with a good mix of tree ages, and natural regeneration, where the understorey is comprised of native grasses and herbs or native shrubs, and which contains a range of habitats for native fauna (such as logs, shrubs, tree hollows and leaf litter), or

(b) moderately disturbed bushland with some regeneration of trees and shrubs, where there may be a regrowth area with trees of even age, where native shrubs and grasses are present in the understorey even though there may be some weed invasion, or

(c) highly disturbed bushland where the native understorey has been removed, where there may be significant weed invasion and where dead and dying trees are present, where there is no natural regeneration of trees or shrubs, but where the land is still capable of being rehabilitated.

LOCAL GOVERNMENT (GENERAL) REGULATION 1999 - SECT 16
16 Guidelines for categorisation of land as wetland

Land that is categorised as a natural area should be further categorised as wetland under section 36 (5) of the Act if the land includes marshes, mangroves, backwaters, billabongs, swamps, sedgelands, wet meadows or wet heathlands that form a waterbody that is inundated cyclically, intermittently or permanently with fresh, brackish or salt water, whether slow moving or stationary.

Appendix 6 - LGA requirements for a POM

LOCAL GOVERNMENT ACT 1993 - SECT 36D

36D Community land comprising area of cultural significance

(1) This section applies to community land that is the subject of a resolution by the council that declares that, because of the presence on the land of any item that the council considers to be of Aboriginal, historical or cultural significance, the land is an area of cultural significance for the purposes of this Part.

(2) A plan of management adopted in respect of an area of land, all or part of which is land to which this section applies, is to apply to that land only, and not to other areas.

(3) A plan of management to be adopted for an area of community land, all or part of which consists of land to which this section applies:

(a) must state that the land, or the relevant part, is an area of cultural significance, and

(b) must, in complying with section 36 (3) (a), categorise the land, or the relevant part, as an area of cultural significance, and

(c) must, in complying with section 36 (3) (b), (c) and (d), identify objectives, performance targets and other matters that:

(i) are designed to protect the area, and

(ii) take account of the existence of the features of the site identified by the council's resolution, and

(iii) incorporate the core objectives prescribed under section 36 in respect of community land categorised as an area of cultural significance, and

(d) must:

(i) when public notice is given of it under section 38, be sent (or a copy must be sent) by the council to the Director-General of National Parks and Wildlife, and

(ii) incorporate any matter specified by the Director-General of National Parks and Wildlife in relation to the land, or the relevant part.

(4) If, after the adoption of a plan of management applying to just one area of community land, all or part of that area becomes the subject of a resolution of the kind described in subsection (1):

(a) the plan of management is taken to be amended, as from the date the declaration took effect, to categorise the land or the relevant part as an area of cultural significance, and

(b) the council must amend the plan of management (and in doing so, the provisions of subsection (3) (a), (c) and (d) apply to the amendment of the plan of management in the same way as they apply to the adoption of a plan of management), and

(c) until the plan of management has been amended as required by paragraph (b):

(i) the use of the land must not be varied, except to the extent necessary to protect any item identified in the council's resolution or in order to give effect to the core objectives prescribed under section 36 in respect of community land categorised as an area of cultural significance, or to terminate the use, and

(ii) no lease, licence or other estate may be granted in respect of the land.

(5) If, after the adoption of a plan of management applying to several areas of community land, all or part of one of those areas becomes the subject of a resolution of the kind described in subsection (1):

(a) the plan of management ceases, as from the date the declaration took effect, to apply to that area, and

(b) a plan of management must be prepared and adopted by the council for that area, and

(c) the plan of management so prepared and adopted must comply with subsection (3).

LOCAL GOVERNMENT ACT 1993 - SECT 36C

36C Community land containing significant natural features

(1) This section applies to community land that is the subject of a resolution by the council that declares that the land, being the site of:

(a) a known natural, geological, geomorphological, scenic or other feature that is considered by the council to warrant protection or special management considerations, or

(b) a wildlife corridor,

is land to which this section applies.

(2) A plan of management adopted in respect of an area of community land, all or part of which is land to which this section applies, is to apply to that area only, and not to other areas of land.

(3) A plan of management to be adopted for an area of community land, all or part of which is land to which this section applies:

(a) must state that the land, or the relevant part, is land to which this section applies, and the reason why, and

(b) must, in complying with section 36 (3) (a), categorise the land, or the relevant part, as a natural area, and

(c) must, in complying with section 36 (3) (b), (c) and (d), identify objectives, performance targets and other matters that:

(i) are designed to protect the area, and

(ii) take account of the existence of the features of the site identified by the council's resolution, and

(iii) incorporate the core objectives prescribed under section 36 in respect of community land categorised as a natural area.

(4) If, after the adoption of a plan of management applying to just one area of community land, all or part of that area becomes the subject of a resolution of the kind described in subsection (1):

(a) the plan of management is taken to be amended, as from the date the declaration took effect, to categorise the land or the relevant part as a natural area, and

(b) the council must amend the plan of management (and in doing so, the provisions of subsection (3) (a) and (c) apply to the amendment of the plan of management in the same way as they apply to the adoption of a plan of management), and

(c) until the plan of management has been amended as required by paragraph (b):

(i) the use of the land must not be varied, except to the extent necessary to protect the features of the site identified in the council's resolution or in order to give effect to the core objectives prescribed under section 36 in respect of community land categorised as a natural area, or to terminate the use, and

(ii) no lease, licence or other estate may be granted in respect of the land.

(5) If, after the adoption of a plan of management applying to several areas of community land, all or part of one of those areas becomes the subject of a resolution of the kind described in subsection (1):

(a) the plan of management ceases, as from the date the declaration took effect, to apply to that area, and

(b) a plan of management must be prepared and adopted by the council for that area, and

(c) the plan of management so prepared and adopted must comply with subsection (3).

Appendix 7 – Recommended Species Lists for Planting within Specific Vegetation Communities

Recommended Species for Planting in Different Vegetation Communities of Mambo Wetland

Moist Coastal Apple Forest		
Scientific Name	**Common Name**	**Description**
Angophora costata	Smooth-barked Apple	Medium tree to 7m
Angophora floribunda	Rough-barked Apple	Small to medium tree
Banksia integrifolia	Coast Banksia	Shrub or tree 6-16m
Banksia robur	Swamp Banksia	Shrub to 1m
Banksia serrata	Old Man Banksia	Small tree, 4-8m.
Banksia spinulosa	Hairpin Banksia	Rounded shrub to 2m
Corymbia gummifera	Red Bloodwood	Tall tree to 30m
Daviesia ulicifolia	Eggs and Bacon	Spiky Shrub to 1.5m
Dianella caerulea	Blue Flax Lily	Tufted herb to 50cm
Dillwynia retorta	Heathy Parrot Pea	Small shrub to 1m
Eucalyptus pilularis	Blackbutt	Tall tree 30-40m.
Eucalyptus robusta	Swamp Mahogany	Medium tree, 20-30m
Glochidion ferdinandii	Cheese Tree	Tall rainforest emergent shrub 4-8m
Leptospermum juniperinum	Prickly Tea Tree	Compact shrub to 1.5m
Leptospermum polygalifolium	Lemon-scented Tea Tree	Graceful shrub to 2.5m
Persoonia levis	Smooth Geebung	Tall shrub to 4m
Pimelea linifolia	Rice Flower	Small shrub to 50cm
Polyscias sambucifolia	Elderberry Panax	Erect shrub to 2m
Trachymene incisa		Erect herb to 50cm

Paperbark / Swamp Oak Complex		
Scientific Name	**Common Name**	**Description**
Acacia sophorae	Coastal Wattle	Shrub 1-2m high.
Casuarina glauca	Swamp Oak	Tree 8-12m
Elaeocharis sphacelata	Tall spike rush	Large rush to 2m
Eucalyptus robusta	Swamp Mahogany	Medium tree, 20-30m
Gahnia clarkei	Saw Sedge	Leafy sedge to 2m
Gahnia sieberiana	Saw Sedge	Leafy sedge to 2.5m
Melaleuca quinquenervia	Broad-leaved Paperbark	Tree, 8-12m
Phragmites australis	Native Reed	Aquatic grass, stems to 2m

Mahogany / Paperbark Swamp Forest		
Scientific Name	**Common Name**	**Description**
Acacia irrorata	Black Wattle	Small tree to 15m
Acacia sophorae	Coastal Wattle	Shrub 1-2m high.
Allocasuarina littoralis	Black She-oak	Smal tree, 3-6m
Angophora costata	Smooth-barked Apple	Medium tree to 7m
Banksia robur	Swamp Banksia	Shrub to 1m
Banksia serrata	Old Man Banksia	Small tree, 4-8m.
Callistemon citrinus	Crimson Bottlebrush	Shrub to 2m
Carex appressa	Tall Sedge	Sedge 70-100cm
Dianella caerulea	Blue Flax Lily	Tufted herb to 50cm
Eucalyptus pilularis	Blackbutt	Tall tree 30-40m.
Eucalyptus robusta	Swamp Mahogany	Medium tree, 20-30m
Gahnia clarkei	Saw Sedge	Leafy sedge to 2m
Gahnia sieberiana	Saw Sedge	Leafy sedge to 2.5m
Juncus usitatus	Common Rush	Clumped sedge to 100m
Lepidosperma flexuosum	Rapier Sedge	Clumped sedge 60-100cm
Lomandra longifolia	Mat Rush	Large tufted herb to 1m
Melaleuca quinquenervia	Broad-leaved Paperbark	Tree, 8-12m
Persoonia lanceolata	Geebung	Bushy shrub to 2m
Persoonia levis	Smooth Geebung	Tall shrub to 4m
Viminaria juncea	Golden Spray	Leafless shrub, 2-3m

Coastal Sand Woodland		
Scientific Name	**Common Name**	**Description**
Acacia myrtifolia	Myrtle Wattle	Small shrub, 50-100cm
Acacia sophorae	Coastal Wattle	Shrub 1-2m high.
Acacia terminalis	Sunshine Wattle	Open shrub to 1.5m
Allocasuarina littoralis	Black She Oak	Smal tree, 3-6m
Angophora costata	Smooth-barked Apple	Medium tree to 7m
Banksia serrata	Old Man Banksia	Small tree, 4-8m.
Banksia spinulosa	Hairpin Banksia	Rounded shrub to 2m
Caprobrotus glaucescens	Pig Face	Creeping succulent herb
Dampiera stricta	Blue Dampiera	Small herb, 20-40cm
Dianella caerulea	Blue Flax Lily	Tufted herb to 50cm
Dillwynia retorta	Heathy Parrot Pea	Spreading shrub to 1m
Eucalyptus pilularis	Blackbutt	Tall tree 30-40m.
Eucalyptus tereticornis	Forest Red Gum	Tall tree 30-40m. Koala food tree
Leptospermum laevigatum	Coastal Tea Tree	Tall shrub to 8m
Leptospermum polygalifolium	Lemon-scented Tea Tree	Graceful shrub to 2.5m
Leucopogon lanceolatus	Lance Beard Heath	Erect shrub, 1.5m
Lomandra longifolia	Mat Rush	Large tufted herb to 1m
Persoonia lanceolata	Geebung	Bushy shrub to 2m
Persoonia levis	Smooth Geebung	Tall shrub to 4m
Scaevola ramosissima	Snake Flower	Scrambling herb to 100cm
Sporobolus virginicus	Sand Couch	Creeping grass