BILLINUDGEL NATURE RESERVE

Plan of Management

NSW National Parks and Wildlife Service

November 2000

This plan of management was adopted by the Minister for the Environment on 15th November 2000.

Acknowledgments:

The draft plan of management for Billinudgel Nature Reserve was prepared by Jane Baldwin, now Community Relations Ranger, North Coast Region, and this adopted plan of management was prepared by Graeme McGregor, Planning Officer, Northern Rivers Region.

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Cover photograph of Scribbly Gum woodland along the edge of the Capricornia Canal by D. Milledge.

NSW National Parks and Wildlife Service

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FOREWORD

Billinudgel Nature Reserve is located on the far north coast of New South Wales and has an area of 713 hectares. It forms one of several coastal nature reserves which protect important remnants of coastal habitat in an otherwise highly modified environment. A core area of the Reserve was dedicated in 1996 with additional lands to the north and south dedicated in 1997. The Reserve includes the beach to the mean low water mark (refer to figure 1). The Reserve was dedicated as part of the Government's New Parks initiative.

The Reserve is part of a regional network of parks and reserves created to conserve natural processes and ecosystems in north-eastern New South Wales. In this role the Reserve protects the following features:

- a large tract of natural lowland coastal vegetation, a significant remnant in an otherwise highly modified environment;
- an extensive wetland containing *Melaleuca* swamp forest;
- a diversity of habitat which supports a wide range of fauna and flora including rare, threatened, significant and migratory species;
- Aboriginal sites and landscapes of significance; and
- features of scientific interest.

This plan draws on the NPWS records and information provided by members of the community. It outlines a broad framework for the management of the Reserve. Management objectives focus on the conservation of natural and cultural heritage values which are special to the Reserve. Management strategies provide for the protection of these values from threats and for appropriate recreational, educational and research use. Many of the strategies have been formulated with the assistance of members of the local community.

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

Bob Debus
Minister for the Environment.

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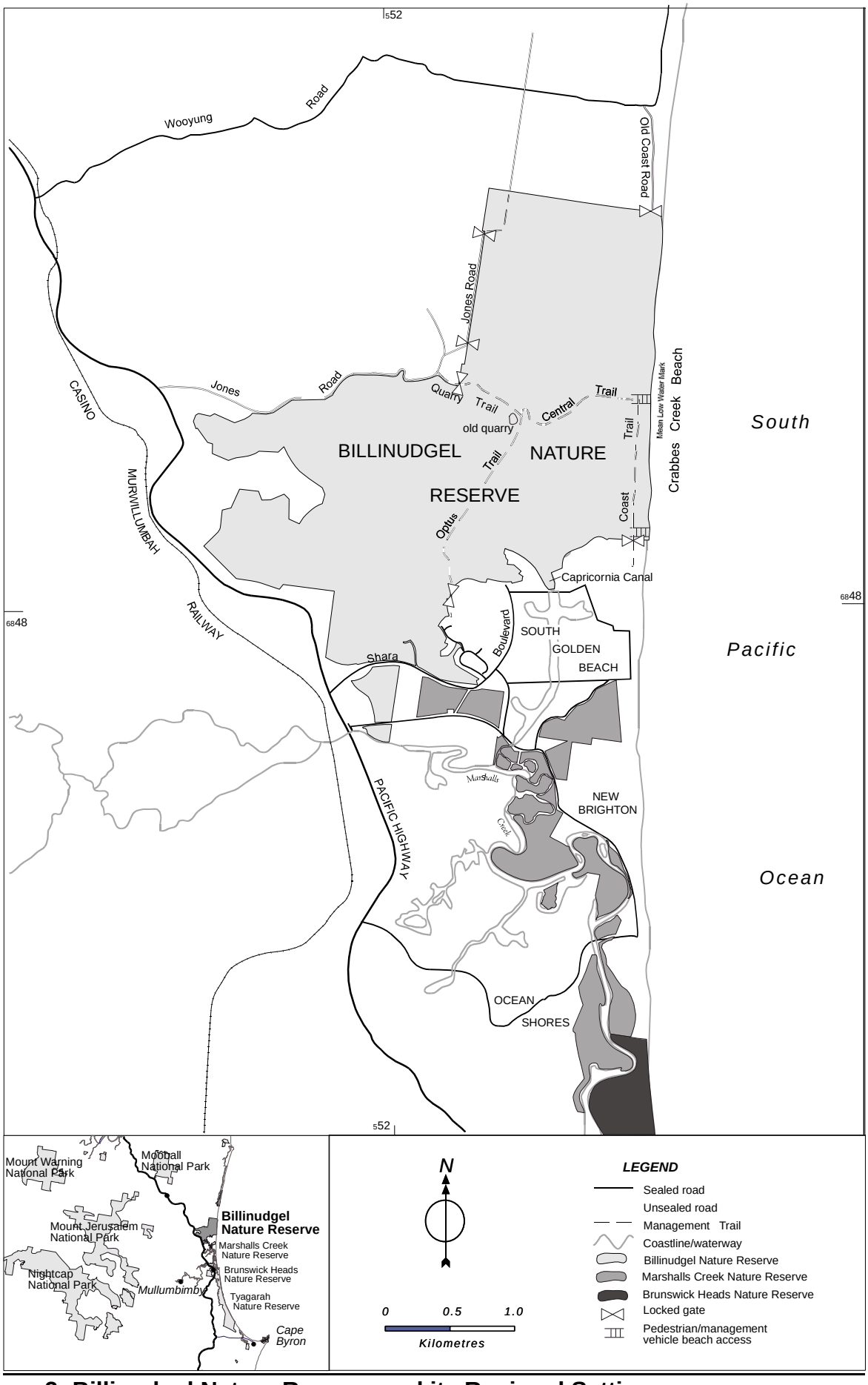

Figure 2: Billinudgel Nature Reserve and its Regional Setting

1. THE PLANNING PROCESS

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

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

- The Director-General is required to refer the plan to the National Parks and Wildlife Advisory Council for its consideration and advice.

- The Director-General is required to submit the plan to the Minister, together with any comments or suggestions of the Advisory Council.

- The Minister may adopt the plan without alteration or with such alterations as the Minister may think fit, or may refer it back to the Director General and Council for further consideration.

Although public exhibition is not a requirement under the Act, the draft plan of management for Billinudgel Nature Reserve was placed on public exhibition for comment on the proposals it contained. The public exhibition period was three months, concluding on 24 May 1999, and attracted 18 submissions covering 13 issues. All comments received were referred to the Advisory Council along with the plan for its consideration and advice. The comments and suggestions of the Advisory Council were, in turn, considered by the Minister in adopting this plan.

Now that the plan has been adopted by the Minister, no operations may be undertaken within the Nature Reserve except in accordance with the plan.

The planning process leading to the development of this plan has involved the collection and use of a large amount of information, which for reasons of document size, has not been included in the plan. For additional information or inquiries on any aspect of the plan, please contact the NPWS Murwillumbah Area Office at the World Heritage Rainforest Centre, Pacific Highway, Murwillumbah 2484 or by telephone on (02) 6672 6360.

2. NATURE RESERVES IN NEW SOUTH WALES

Reserving areas for nature conservation was introduced into Australia with the establishment of Royal National Park in 1879.

Fauna Reserves in New South Wales were established under the *Fauna Protection Act, 1948.* Under the *National Parks and Wildlife Act, 1967*, fauna reserves were reclassified as nature reserves. The *Fauna Protection Act* was replaced by the *National Parks and Wildlife Act* (NP&W Act) in 1974.

Nature reserves are considered to be valuable refuge areas where natural processes, phenomena and wildlife are protected and can be studied. Nature reserves differ from national parks as they do not include provision of recreation opportunities as a major objective of their management.

The purpose of a nature reserve is defined under the NP&W Act as being:

- the care, propagation, preservation and conservation of wildlife;
- the care, preservation and conservation of natural environments and natural phenomena;
- the study of wildlife, natural environments and natural phenomena; and
- the promotion of the appreciation and enjoyment of wildlife, natural environments and natural phenomena.

3. BILLINUDGEL NATURE RESERVE

3.1 Location, Dedication and Regional Setting

Billinudgel Nature Reserve (referred to as “the Reserve” in this plan) is situated approximately 850 km north of Sydney, 160 km south of Brisbane and 35 km north east of Lismore in upper north east New South Wales (referred to as “the region” in this plan). The Reserve is located on the coast between the townships of Byron Bay and Kingscliff. Approximately 75% of the Reserve is within Byron Shire with the remainder in Tweed Shire (refer to figure 1).

The southern boundary of the Reserve is convoluted and abuts the residential development of North Ocean Shores. Grazing, banana plantations and cane lands adjoin the northern and western sides of the Reserve. The majority of the Reserve is coastal floodplain with two ridgelines to the west. The Reserve extends eastward to the mean low water mark of the South Pacific Ocean on Crabbes Creek Beach.

A core area of 357 hectares was dedicated, pursuant to the NP&W Act, as a nature reserve in April 1996. Two areas of 189.5 hectares and 166.6 hectares were purchased in late 1996 and dedicated as an addition to the Reserve in 1997. The total area of the Reserve is now approximately 713 hectares.

The climate is coastal subtropical. December to April is warm and wet with mean maximum temperatures ranging from 25ºC - 30ºC. The period from May to November is cooler and drier, with September recording the lowest average monthly rainfall. Seasonal rainfall variability can be great and there may be large differences in rainfall received from one year to the next. Generally, nearly 70% of the year’s average rainfall of 1,650 mm falls mid to late summer. South-westerly winds prevail in the winter months and south-easterly winds dominate the summer months.

The Reserve is located in a zone of overlap between two biogeographical regions known as the McPherson-Macleay Overlap (Burbidge 1960). This zone extends

roughly from the Queensland border to the Hunter Valley in New South Wales. It is a zone where subtropical (Torresian) and temperate (Bassian) species intermix - a factor, according to the NPWS (1995a), which contributes to the richness of fauna in the Reserve. Other factors include wide landform and soil variation and mild climate promoting plant growth throughout the year (Nix 1976; Gilmore *et al.* 1986; Milledge 1991).

Areas of native vegetation to the north and south of the Reserve provide a link between the Reserve and other protected areas including Brunswick Heads Nature Reserve and Mooball National Park (NPWS 1987). These links potentially enable the movement of species in response to seasonal flowering, breeding or fire and may assist in maintaining coastal populations of plants and animals (NPWS 1995a; Gilmore *et al.* 1986).

The Reserve forms part of a wider system of Reserves which conserve important coastal systems such as those found in Ukerebagh, Cudgen, Broken Head, Ballina, Tyagarah, Marshalls Creek and Brunswick Heads Nature Reserves.

3.2 Natural and Cultural Heritage Values

3.2.1 Landscape, landform and hydrology

Billinudgel Nature Reserve is an important part of the landscape value of the Byron-Tweed coast and is of particular scenic and passive recreational value to nearby rural residential and urban areas. Byron and Tweed Shire Councils have recognised the visual amenity of this coastal landscape in respective landscape evaluations. Features which contribute to the visual amenity of the Reserve include a long expanse of sand beach, coastal plain and vegetated ridgelines in the west. Plant communities which specifically contribute to the aesthetics include the coastal cypress pine stand, the mature eucalypt forests, the scribbly gum and banksia woodland, and the broad-leaved paperbark forests, particularly during the flowering season.

Billinudgel Nature Reserve encompasses five distinct terrain units, each of which represents a period in the geomorphological history of the Reserve. These include a Holocene sand barrier bordering the Pacific Ocean which marks recent beachfronts; a low lying inter-barrier floodplain of marine and fluvial sediments; a Pleistocene sand barrier representing an older series of beach fronts further to the west; a low lying western floodplain of fluvial deposits; and an elevated series of metamorphic bedrock ridges which border the Reserve on the western boundary (Navin 1990; NPWS 1995a).

Catchment runoff originates from vegetated and cleared agricultural lands to the west of the Reserve via Billinudgel and Yelgun Creeks. These waters enter the Billinudgel wetland within the Reserve (refer to figure 1). The catchment is mapped as class 3 and 5 on the Byron Shire Acid Sulphate Soils Map, which limits works that could affect the water table.

The flow of water is constricted by a bundwall (levee) across the floodplain under the Optus Trail (refer to figure 1), and the wetland is drained by a large drain constructed through the old dune system to the north of the bundwall. Drainage from this point

occurs across the inter-barrier floodplain in an eastward then southward direction by a series of drains, then into the Marshalls Creek system via an artificial channel known as Capricornia Canal (refer to figure 1). Under peak flow conditions, however, floodwaters may also move northwards across the floodplain into the Mooball Creek system (M. Lambourne, pers. comm. 1999).

Prior to European settlement, the Reserve landscape would have been one of more permanent and widespread interbarrier floodplain wetlands. Original land surveys show the floodplain as “swamp with ti (tea) tree” with very few drainage lines. The idea of a previously more waterlogged environment is supported by an absence of Aboriginal sites on the inter-barrier floodplain compared to the numerous middens which are found elsewhere in the Reserve (Navin 1990). The wetness associated with the western section of the Billinudgel wetland appears to be assisted by the bunding action of the Optus Trail. It is, however, capable of being traversed by foot during periods of dry weather.

According to parish maps and land surveys, small agricultural drains were constructed in the northern section of the Reserve shortly after 1910. More recent developments have involved larger drainage works. These changes include:

- Construction of a “Drainage Union” drain through the northern section of the Reserve, partly along one of the few naturally occurring drainage lines in the Reserve. The drain connected part of the Crabbes Creek wetlands to the former “Billinudgel Creek” which originally entered the ocean via a natural flood outlet south of Wooyung.
- Construction of a canal in the late 1950s to drain the South Golden Beach residential development into Marshalls Creek. This canal drained southern parts of the floodplain in the Reserve.
- Construction of a bundwall located on the Optus Trail and a major drain through the old dune system to drain the Billinudgel wetland as part of a 1970's development proposal to construct a canal estate adjacent to the wetland.
- Construction of an east-west aligned drain from the Optus Trail drain to the coast in 1973, in preparation for a proposed canal estate development. This drain breached the coastal dune and was intended to be developed as a permanent flood outlet. The ocean outlet was closed in 1976 by the developer in response to a Council request to repair the Coast Trail (refer to figure 1). A navigable entrance was a Bond Corporation proposal in the early 1980s.
- Construction in the 1970s of a large canal (the Capricornia Canal) in the southern part of the Reserve which drains the floodplain. Numerous small artificial drainage lines connect with the northern section of this canal. The Capricornia Canal extends south into the Marshalls Creek system and forms part of the North Ocean Shores residential development (refer to figure 1).

The blocking of the natural drainage system by man-made obstructions is probably the most significant hydrological modification in the Reserve. These alterations

appear to have altered ground water levels and the depth and duration of surface water inundation in the surrounding *Melaleuca* forest and palm forest. It is likely to have also altered the nature and extent of flood flows (Navin 1990; Gilmore *et al.* 1986).

Hydrological processes in the Reserve have been well researched but the impact on vegetation type and habitat value of the above drainage works is not well understood. A potentially major threat to the Reserve is the proposal to lower the bund wall (known as the Kalaroo Circuit bund) of the Capricornia canal in an attempt to aid drainage of cane lands. Such works may have significant adverse hydrological implications for the Reserve, leading to a lowering of the water-table, release of acidic waters, drying out of the southern section of the Reserve, and resultant changes to the vegetation communities.

Limited analyses of water quality have been undertaken in the Reserve. Existing data reflects water quality in the Capricornia Canal, where samples were taken, rather than reflecting water quality in the catchment. During 1997, the Department of Land and Water Conservation in conjunction with the Brunswick Catchment Management Committee installed a data-logger in the canal within the Reserve. The data is yet to be analysed.

3.2.2 Native flora

Past systematic flora studies of the Reserve area were undertaken between 1985 and 1990 and include work by Broadbent and Stewart (1986), Gilmore *et al.* (1986) and Benwell and Milledge (both unpublished) (NPWS 1996).

A survey undertaken by Gilmore *et al.* (1986) identified 23 broad vegetation types in the Reserve and is the most comprehensive report on flora and fauna in the Reserve to date. The classification types used by Gilmore *et al.* (1986) are structural-ecological types designed to reflect fauna habitat rather than floristic associations (NPWS 1996). However, they provide a picture of the vegetation cover of the Reserve. The types include:

- regenerating and undisturbed wet sclerophyll forest;
- regenerating and dry sclerophyll forests;
- dry sclerophyll woodlands;
- dune and floodplain swamp forest ecotones;
- regenerating and undisturbed dune swamp sclerophyll forests;
- regenerating and undisturbed floodplain swamp sclerophyll forest;
- swamp rainforest;
- littoral scrub;
- heath scrub;
- wet heath;
- fern-sedge swamp;
- tall grassland;
- low grassland-open ground; and
- open fresh water.

In a revision of the Gilmore *et al.* (1986) vegetation map, the NPWS (1996) reclassified the vegetation communities for a small section of the Reserve, giving a greater indication of the composition of these forest types. The communities are:

- frontal dune complex - coastal wattle (*Acacia longifolia var. sophorae*) shrubland and coastal spinifex (*Spinifex hirsutus*) grassland;
- littoral scrub - coast banksia (*Banksia integrifolia ssp. B*) - black sheoak (*Allocasuarina littoralis*) low open to closed forest;
- littoral rainforest - coastal aspen (*Acronychia imperforata*) - ribbonwood (*Euroschinus falcata*) - lillypilly (*Acmena hemilampra*) open to closed forest;
- open areas (grassland, low swamp - forest regrowth, fern / sedge swamp);
- swamp oak (*Casuarina glauca*) regenerating swamp sclerophyll, open forest;
- coastal open forest- swamp turpentine (*Lophostemon suaveolens*) - swamp mahogany (*Eucalyptus robusta*) - red mahogany (*E. resinifera*) - paperbark (*Melaleuca quinquenervia*) open forest;
- sedge heath - coastal bottlebrush (*Callistemon pachyphyllus*) - soft twig rush *(Baumea rubiginosa*) - Bungwahl fern (*Blechnum indicum*) closed heath;
- open forest / swamp forest ecotone (littoral rainforest) - hard corkwood (*Endiandra sieberi*) open to closed forest;
- coastal cypress pine (*Callitris columellaris*) open forest; and
- scribbly gum (*Eucalyptus. signata*) - banksia (*Banksia aemula*) - tea tree (*Leptospermum trinervium*) open forest and woodland.

Ideally, the Gilmore *et al.* (1986) vegetation map covering the remainder of the Reserve would be revised to produce a common vegetation classification for the Reserve.

The Reserve protects a remnant of coastal lowland vegetation which is significant at a regional and state level for its numerous rare and threatened species and restricted or poorly conserved plant communities (NPWS 1995a).

A diversity of vegetation exists reflecting variations in landform, soil type, fire history and climate. Disturbance associated with past land use has contributed to this diversity by creating many regenerating forms of forest. These are interspersed with undisturbed stands of forest and open grasslands (NPWS 1996; Gilmore *et al* 1986; Broadbent and Stewart 1986). There are also a number of ecotonal type forests. Ecotones are structurally complex providing a variety of resources to a range of fauna. Ecotones found in the Reserve are often linear in shape and assist in the movement of fauna through the Reserve (Gilmore *et al.* 1986).

There are approximately 450 plant species found within the Reserve (NPWS 1990; NPWS 1995a). Of these, five species are listed under the *Threatened Species Conservation Act, 1995.* These include the endangered species, fragrant achronychia (*Acronychia littoralis)* and Davidson's plum (*Davidsonia pruriens* var*. jerseyana)*, and the vulnerable species, corokia (*Corokia whiteana*), rusty rose walnut (*Endiandra hayesii*) and coolamon tree, or durobby (*Syzygium moorei*) (Gilmore *et al.* 1986; NPWS 1995 a, b; Jago 1996; Balanced Systems Planning 1996; NPWS 1987). The basket fern (*Drynaria rigidula),* an endangered species presumed to have been extinct in New South Wales, has been recorded in the northern part of the Reserve and from only a small number of other sites in the State, including three sites in Byron Shire. Significant plant species and plant communities are presented in Table 2 of Appendix A.

In addition to the communities identified in Table 2 of Appendix A, Melaleuca forest, while not regionally uncommon or poorly conserved, is significant. Over 250 ha of

Melaleuca quinquenervia swamp sclerophyll forest occurs in the Reserve and is the most extensive of the natural vegetation communities found there.

In contrast to many of the other vegetation types in the Reserve, a large part of the Melaleuca forest appears to have not been disturbed by prior land use. Most of this forest is subject to State Environmental Planning Policy No. 14 - wetlands. Broadbent and Stewart (1986) proposed that even though the conservation status of *Melaleuca quinquenervia* in New South Wales is considered to be good, the Billinudgel Swamp should be considered of regional and probably state-wide significance because of:

- high numbers of endangered and significant species (possibly the highest in NSW);
- a well-developed rainforest element, providing high habitat diversity;
- adjacent wet sclerophyll forest, again adding to habitat diversity and variability; and
- sufficient size to maintain a rich and diverse flora and fauna.

Other significant and threatened plant species are known to occur in the general area and it is reasonable to believe that some of these may also be found in the Reserve (Balanced Systems Planning 1996).

3.2.3 Native fauna

Over 170 species of fauna have been recorded in the Reserve, the majority of these are birds. Other species may occur as some groups of fauna have not been systematically surveyed (NPWS 1995a). The range of fauna is attributed to a diversity of vegetation and habitat types and the location of the Reserve in a region of high biodiversity (refer to section 3.1).

The Reserve functions as a refuge for specialised wetland fauna, fauna dependent on old growth forest elements and rainforest. The diversity of habitat found in the Reserve, particularly those habitats associated with the swamp sclerophyll forest and woodland and other wetland communities, gives the Reserve a major refuge function for an assemblage of species which have suffered substantial habitat losses and are currently poorly conserved in the existing regional and state reserve system. These are predominantly specialised wetland species which include:

- the vulnerable wallum tree frog (*Crinia tinnula*), black bittern (*Ixobrychus flavicollis*), Australasian bittern (*Botaurus poiciloptilus*), brolga (*Grus rubicunda*), bush-hen (*Gallinula olivaceus*) and comb-crested jacana (*Irediparra gallinacea*)
- the regionally significant laughing tree frog (*Litoria tyleri*), sandy gungan (*Uperoleia fusca*), great egret (*Ardea alba*), royal spoonbill (*Platalea regia*), Lewin's rail (*Rallus pectoralis*) and spotless crake (*Porzana tabuensis*)
- species closely associated with wetland communities such as the vulnerable grass owl (*Tyto capensis*)
- regionally significant brahminy kite (*Haliastur indus*), little bronze-cuckoo (*Chrysococcyx minutillus*), forest kingfisher (*Todiramphus macleayii*) and grassland melomys (*Melomys burtoni*) (NPWS 1995a).

The rainforest or mesic vegetation elements associated with the paperbark (*Melaleuca quinquenervia)* - swamp mahogany (*Eucalyptus robusta*) - swamp turpentine (*Lophostemon suaveolens*) open forests are characteristic of these

forests on the New South Wales far north coast (Broadbent and Stewart 1986) and are especially important for rainforest associated fauna. The Reserve contains the largest and most intact remaining stands of these swamp sclerophyll forest - rainforest association on the far north coast (Broadbent and Stewart 1986) and they give the Reserve an additionally significant function as a coastal rainforest refuge. Fauna species dependent on these habitats include:

- the vulnerable wompoo fruit-dove (*Ptilinopus magnificus*), rose-crowned fruit-dove (*P. regina*), white-eared monarch (*Monarcha leucotis*), Yellow-eyed Cuckoo-shrike (*Coracina lineata),* black flying fox (*Pteropus alecto*), Queensland blossom-bat (*Syconycteris australis*) and northern long-eared bat (*Nyctophilus bifax*), and
- the regionally significant Murray's skink (*Eulamprus murrayi*), yellow-bellied skink (*E. tenuis*), carpet python (*Morelia spilota*), rough-scaled snake (*Tropidechis carinatus*), Pacific baza (*Aviceda subcristata*), little shrike-thrush (*Colluricincla megarhyncha*), spectacled monarch (*Monarcha trivirgatus*), varied triller (*Lalage leucomela*) and regent bowerbird (*Sericulus chrysocephalus*) (NPWS 1995a).

The old-growth forest elements throughout a number of stands are of high value to many specialised species, particularly hollow dependent species, in providing food, den and nest site resources, and are a scarce resource on the far north coast as a result of widespread clearing and disturbance. Species dependent on these resources include:

- the vulnerable osprey (*Pandion haliaetus*), square-tailed kite (*Lophoictinia isura*), wompoo fruit-dove, glossy black-cockatoo (*Calyptorhynchus lathami*), masked owl (*Tyto novaehollandiae*), koala (*Phascolarctos cinereus*), black flying-fox, Queensland blossom-bat, little bentwing bat (*Miniopterus australis*) and northern long-eared bat, and
- the regionally significant Pacific baza, brahminy kite, white-bellied sea-eagle (*Haliaetus leucogaster*), forest kingfisher and little shrike-thrush (NPWS 1995a).

The importance of the Reserve's wallum plant communities in providing over-wintering habitat for a suite of birds and bats has been well established (Gilmore *et al.* 1986, Milledge 1991). Gilmore *et al.* (1986) highlights the importance of the Reserve as primary regional over-wintering habitat for these fauna noting large influxes of birds at certain times of year. Much of the fauna that rely on the Reserve's lowland habitats are nomadic and migrate to the Reserve when feeding resources become abundant, or undertake altitudinal and latitudinal movements in response to climatic and seasonal changes.

A particularly significant threatened species which over-winters in the Reserve is the Queensland blossom bat (*Syconycteris australis*) (Nix 1976; Hogg 1984; Gilmore *et al.* 1986; JTWC planning 1986). Other species include:

- altitudinal migrants such as the vulnerable wompoo and rose-crowned fruit-doves and white-eared monarch;
- the regionally significant little shrike-thrush;
- latitudinal migrants such as the regionally significant little bronze-cuckoo, forest kingfisher, spectacled monarch and spangled drongo (*Dicrurus bracteatus*), and
- the nomadic, endangered regent honeyeater (*Xanthomyza phrygia*) (NPWS 1995a).

The Reserve is also likely to function as a corridor for faunal movements between the coast and the hinterland. The continuation of these links may be important to the long term maintenance of local and regional fauna populations.

Forty-four threatened species of fauna as listed under the TSC Act, 1995, have been recorded in the Reserve. These are presented in Table 3 in Appendix A.

Other threatened and regionally significant fauna species have been recorded in the general area and it is likely that these species may also inhabit or frequent the Reserve (Balanced Systems Planning 1996).

3.2.4 Culturally significant sites and places

Prior to European settlement, the Bundjalung people occupied the north-east corner of NSW (Calley 1964; Navin 1990). Within the Bundjalung nation there were a number of tribes. The Minjungbal tribe is recorded as occupying the area between Byron Bay and Southport, extending inland to Murwillumbah. The Coodjingburra clan is believed to have occupied the coast between the Tweed and Brunswick River (Navin 1990; NPWS 1997a).

Settlement patterns of the Bundjalung Nation have also been debated by several authors. Aboriginal population densities are generally accepted as being higher on the coast than the hinterland. This is attributed to the variety of resources the coastal strip offered. The use of the Reserve area by Aboriginal people is likely to have been high given the variety of terrain types, vegetation and the ease of access the ridges provided to the coastal floodplains. A large number of middens occur in the Reserve on the ridge spurs and sand barriers indicating a local abundance of food. These sites together with other types of sites across both Holocene and Pleistocene deposits attest to a long period of Aboriginal occupation in the Reserve (Navin 1990).

A limited number of archaeological surveys have been conducted in the Reserve and the general area since the late 1970's. A survey by Navin (1990) has provided the greatest level of information.

There are 16 recorded Aboriginal sites in the Reserve, excluding the recent detailing of a mythological site (Conservation of North Ocean Shores (CONOS). pers. comm.). These sites include a scar tree, bora ring, stone artefact scatters and isolated finds which indicate camp sites, hunting and gathering activities and travel routes (Navin 1990).

The NPWS detailed the presence of the ceremonial double bora ring and associated shell midden complex in the northern part of the Reserve in 1977.

The bora ground is considered regionally important as it is relatively well preserved and remains in a natural context compared to other bora grounds located in urbanised or rural environments. The site is important to local Aboriginal people and there is a claimed custodial relationship by a living Aboriginal person (Navin 1990; NPWS 1996).

Navin (1990) described the "old dune" in the Reserve as being archaeologically sensitive, it appears to have been used as a base camp providing a point from which

the resources of the area were utilised and may hold many unknown archaeological sites. Navin identified other significant sites within the Reserve including two middens, which are of an uncommon type both in a local and regional context, and a scar tree which is of a type considered rare. Two other more standard midden types located in the Reserve were regarded by Navin as significant because of the likelihood of insitu subsurface material. Several artefact scatters were also assessed as significant as they occur in association with the bora ground. One particular artefact scatter is locally significant because it lies in a geographical context which is different from the other artefact scatters found.

Non-indigenous settlement of the Reserve occurred from the 1860s and centred on logging, dairying, grazing and, later, mineral sand mining. Farming was limited to areas of suitable soil and drainage. It was largely abandoned on the coastal plain by the 1950s. A few farms remain in the Marshalls Ridges area. Other adjacent areas have been developed for residential use.

The historical significance of the historic sites which remain in the Reserve has not been assessed. Old drains and the concrete foundations of a former dairy in the Marshalls Ridges area may be of historical significance given their age and the period of settlement represented.

3.2.5 Research opportunities

The majority of scientific research in and around the Reserve was undertaken during the 1980s and early 1990s. This research was associated with a number of development proposals for the area and later efforts to formally recognise and conserve the cultural and natural values of the area. It provides a useful indication of Reserve values but is by no means exhaustive.

Several areas of future research and monitoring which could assist the long-term conservation of natural and cultural values and management of similar parks and reserves include:

- relationship of hydrology and habitat;
- opportunities to rehabilitate degraded wetlands;
- original vegetation types and opportunities to re-establish such in the Reserve;
- assessment of water quality and source points of poor water quality;
- updated baseline information on flora and fauna;
- impact of fire management operations of plant communities and fauna populations and fire frequency and intensity on vegetation;
- potential for habitat enhancement of land used previously for mineral sand mining and agriculture;
- monitoring of introduced plant and animal control programs;
- monitoring and management of visitor impacts; and
- survey of archaeologically sensitive areas.

The Reserve is significant for its relatively undisturbed wetland which contains deep beds of peat. Peatlands are the only type of ecosystem to record their own long term history. Peat preserves organic material and core samples can provide evidence of change or single events associated with climate, fire, vegetation and geomorphology over time (Legoe 1981), providing a unique scientific resource.

4. MANAGEMENT DIRECTION AND OBJECTIVES

4.1 Management Direction

The implementation of this Plan over the next five to ten years aims to ensure:

- ongoing natural ecological processes;
- a good understanding of ecological processes and their relationship to hydrology;
- infrastructure and procedures in place for fire prevention and control;
- provision for passive nature based recreation utilising only basic facilities;
- control of introduced plants, with some species being eliminated from the Reserve;
- promotion of research associated with Reserve management and ecological processes;
- extensive community involvement in interpretation and protection of the Reserve, and
- exclusion of incompatible uses, including public vehicular access, from the Reserve.
- promotion of research associated with Reserve management and ecological processes.

4.2 General Management Objectives

The following general objectives are described in the NP&W Act and relate to the management of nature reserves by the NPWS in New South Wales:

- protection and preservation of scenic and natural features;
- maintenance of natural processes as far as is possible;
- Maintain species diversity and abundance within the Reserve;
- conservation of wildlife;
- preservation of Aboriginal sites and historic features;
- encouragement of scientific and educational inquiry into environmental features and processes;
- preservation of the Reserve as part of a regional network of parks and reserves which conserve natural processes and ecosystems, and
- conservation of habitat diversity.

4.3 Specific Management Objectives

In addition to the above objectives, the following specific management objectives apply to this Reserve. These objectives are directly associated with the protection of those natural and cultural heritage values which are special to this Reserve. They are:

- protection of Billinudgel wetland and its diverse flora and fauna;
- protection of wet sclerophyll forest found adjacent to the wetland;
- preservation of primary over-wintering habitat utilised by a range of migratory fauna;
- protection of the wetland peat deposit as a site of scientific interest;
- conservation of Aboriginal sites and the cultural significance of the landscape;
- protection of habitat used by specialist fauna including wetland and rainforest species and species dependent on old growth elements; and

- promote the value of continuous native vegetation as habitat for fauna and flora, and as movement corridors for nomadic, seasonal and migratory species.

5. NATURAL AND CULTURAL HERITAGE MANAGEMENT

The following section provides a framework for the management of Billinudgel Nature Reserve. The management of the Reserve aims to achieve both the general and specific objectives outlined in previous sections. To accomplish this, the management operations focus on processes, activities and issues which threaten the natural and cultural heritage values of the Reserve.

The following section details specific threats and management requirements and proposes one or a number of "management strategies" in response. The strategies are supported by a statement of "desired outcomes" which identifies the general benefits of implementing the proposed strategies.

5.1 Landform Soils and Hydrology

5.1.1 Coastal erosion and ocean breakthrough

Coastal erosion and ocean breakthroughs are part of the natural geomorphological processes of the Australian coastline. However, in an area such as Crabbes Creek Beach, the foredune is at risk of accelerated erosion and ocean breakthrough. This is because of its low relief, narrow nature and areas of instability associated with mineral sand mining, inappropriate recreational activities and naturally occurring coastal recession.

The risk of ocean breakthrough increases during a storm event. Saltwater inundation and intrusion into the watertable may adversely affect freshwater plant communities located behind the foredune and perhaps those further in the Reserve.

Management strategies

i. Any activity which has the potential to degrade the dune system in the Reserve will be restricted or prohibited.

ii. Encourage research which identifies locations along the foredune that are low, narrow, degraded and vulnerable to accelerated erosion and ocean breakthrough.

iii. In appropriate locations, undertake works to encourage the accretion of sand and revegetation of native species.

iv. Encourage the assistance of local community groups in planning and undertaking rehabilitation works in the foredune area.

Desired outcomes

(a) To have restored degraded and potentially unstable areas of the Crabbes Creek Beach foredune through native vegetation regeneration and sand accretion works.

(b) To have the local community actively participating in dune repair activities and strengthen the community's sense of "ownership" of this resource.

(c) There is no unnatural degradation of the dune system.

5.1.2 Acid sulfate soils

Acid sulfate soils are found in coastal environments and are a legacy of the geomorphological development of the area. When exposed to air, acid sulfate soils produce sulfuric acid. Leached into nearby waterways, this acid has deleterious effects on water quality and aquatic organisms.

The exposure of acid sulfate soils to air occurs through soil disturbance or the lowering of watertables. Human activities such as drainage and excavation exacerbate the acidification of soil and water. The leaching of acid from soil to water is generally associated with large rainfall events. Acid may enter a stream via surface runoff or through groundwater flow.

Management strategies

i. Any earthworks which have the potential to disturb the acid sulphate soils will require an appropriate environmental assessment before works are undertaken.

ii. If acid sulfate soils are encountered during the assessment process, plan the works in a manner which minimises the risk of exposing acid sulfate soils and creating acid discharge.

iii. In appropriate situations, request an assessment of impacts for proposed external developments which may lower the water table level or disturb acid sulfate soils resulting in the discharge of acid water into or from the Reserve.

Desired outcome

(a) That there has been no increase in the potential for the Reserve to be affected by soil and water acidification.

5.1.3 Hydrology, wetland and vegetation

Wetland communities are dependent on high water tables or extended periods of surface water inundation. The long term survival of other vegetation types may be dependent on maintaining a lower watertable and free draining soils.

The potential exists for the natural values of the Reserve to be affected by hydrological change, either inside or adjacent to the Reserve (NPWS 1990). Given the pre-existing modifications to hydrology, scientific research is required to

understand both past and present relationships between hydrology and vegetation. This information may then be used to guide future management decisions which concern hydrology in the Reserve.

Modifications to hydrology can have a deleterious impact on an ecosystem (Holmes 1989). Peat fires are a particular concern in Billinudgel Wetland. Fire may occur in situations where peat becomes overly dry from the permanent lowering of water tables by adjacent drainage works. Peat fires may smoulder for considerable periods and damage or destroy important wetland habitat and stands of *Melaleuca* or rainforest. The loss of peat through fire may influence local hydrological conditions and alter natural vegetation cover, potentially adversely affecting habitats and significant species of flora and fauna.

Peat is also an important scientific resource and its scientific values can be destroyed by fire. In conditions conducive to wildfire, there is a significant risk of fire escaping to the Reserve from cane fields located at Yelgun. This risk could be reduced by managing hydrology to maintain high watertables or extending periods of surface inundation. Such management, however, needs to take into account the hydrological and fire requirements of other habitat and wildlife found in the Reserve.

Management strategies

i. Encourage appropriate scientific research of the relationship between hydrology, vegetation cover and habitat value in the Reserve.

ii. Exercise the precautionary principle with respect to management operations which may affect hydrology in the Reserve until further understanding of hydrological relationships is gained.

iii. As information comes to hand, determine additional hydrological management requirements for the Reserve and implement accordingly.

iv. Any alteration that may be proposed to the hydrology of the Reserve, including alterations to the “Drainage Union” drain, bundwall under the Optus Trail or the Kallaroo bund on the Capricornia canal, will require an environmental impact assessment. (Although the Kalaroo Circuit bund is just outside the Reserve, any alteration to it may significantly impact on the hydrology of the Reserve). Works should not be undertaken unless they improve the natural environment systems of the Reserve and surrounding catchment..

Desired outcomes

(a) The hydrological needs of the wetland communities have been identified.

(b) All internal and external activities which may affect the Reserve’s hydrology have been assessed.

(c) The relationship and management requirements of hydrology, vegetation and habitat in the Reserve are better understood.

5.1.4 Maintaining water quality

The Reserve lies at the base of a small coastal sub-catchment draining into the Brunswick River. Billinudgel and Yelgun Creeks flow from the west into Billinudgel Wetland within the Reserve.

Water runoff drains from urban, rural and natural lands surrounding the Reserve. Maintaining high water quality is important as some wetland fauna are sensitive to poor water quality and chemical contamination. Poor water quality may also damage aquatic habitat; erosion, sedimentation and nutrient movements can create changes in conditions rendering habitat unsuitable for dependent fauna (Pressey and Harris 1988; Gilmore and Parnaby 1994; NPWS 1997a).

Management strategies

i. Design and undertake management operations in a way which minimises soil erosion and protects water quality.

ii. Encourage research which assesses the impact of catchment land use activities on water quality, wetland habitat and fauna within the Reserve.

iii. The EPA, DLWC and relevant Shire Council will be advised of any deterioration in the quality of water entering the Reserve from surrounding catchments so that appropriate remedial action can be taken.

iv. Support relevant agencies in their efforts to regulate or educate in the use and impacts of agricultural chemicals in the catchment.

v. Encourage relevant authorities to protect vegetated lands which buffer the Reserve, particularly Billinudgel wetland.

vi. Participate in Catchment Management Committee's activities regarding soil and water quality in the Reserve's catchment.

Desired outcome

(a) There has been no deterioration in water quality in the Reserve.

5.2 Native Plants and Animals

5.2.1 Native vegetation

The Reserve covers a large remnant of coastal low-land vegetation and includes areas of past disturbance resulting from mineral sand mining, agriculture and selective logging. The many regenerating types of forest appear to add to the range of habitat available.

The management of vegetation may involve a combination of passive and active measures which aim to maintain or enhance the natural processes and ecosystems and continue to support a diversity of fauna. This habitat diversity supports a large diversity of fauna, particularly avifauna.

Management strategies

i. Sensitive vegetation communities, such as rainforest, old growth forest, littoral rainforest and coastal cypress pine communities will be protected from the threatening processes of fire and weed invasion.

ii. Influences which may inhibit the natural regeneration of native plant communities, such as weed invasion and wildfire, will be controlled.

iii. Investigate the need for active management of forest types to maintain the habitat requirements of threatened or significant species.

iv. Update and reclassify existing vegetation maps for the Reserve, so that there is a common vegetation classification map for the Reserve.

Desired outcomes

(a) The current diversity of flora and fauna species, and populations of threatened and significant plant species, have been maintained or enhanced.

(b) The natural ecological processes in the Reserve, including the succession of regenerating forest communities, have been unaffected.

(c) The vegetation map for the Reserve has a uniform vegetation classification.

5.2.2 Threatened species management

A number of flora and fauna species are recognised as vulnerable, endangered or significant (refer to Tables 1 and 3, Appendix A). Many of the existing fauna records require validation. Some plant populations in the Reserve may require specific management measures to enhance their numbers to ensure long term viability. These species include:

- rare and threatened plant species, such as Davidson's plum, rose walnut and coolamon tree, where only one or two plants are known to exist in the Reserve;
- rainforest complexes which have been lost or greatly reduced through past disturbance of wet sclerophyll forest, littoral rainforest and vegetation on the ridges (A. Benwell pers. comm.);
- species which have been lost from the Reserve such as the swamp orchid (*Phaius australis*), and
- forest red gum and other tree species along the Marshalls Ridges which are used as a koala corridor but are greatly reduced in number from clearing and selective logging.

The specific management requirements of threatened species in the Reserve have not yet been investigated.

Management strategies

i. Undertake appropriate research to establish management prescriptions designed to protect threatened and significant species from threatening processes. Where necessary, restore associated habitat.

ii. Implement species recovery plans as they become available for threatened species which occur in the Reserve.

iii. Where appropriate, undertake the restoration of significant vegetation associations including rainforest types which once occurred in the Reserve.

Desired outcome

(a) There is no decline in populations of threatened and significant species in the Reserve and there is improved management of threatening processes.

5.2.3 Wildlife corridors

The vegetated links between coastal and hinterland forest areas potentially enable the movement of species, assisting in the maintenance of diversity and the long term viability of plant and animal populations in the Reserve. Areas of natural vegetation on private lands which adjoin the Reserve are considered to be an important part of this corridor system (Gilmore *et al.* 1986). Some areas of vegetation such as those around Marshalls Ridges, Shara Boulevard and Marshalls Creek Nature Reserve also have important habitat values for species such as the koala (Australian Koala Foundation (AKF) in NPWS, 1995a). The majority of these areas are narrow and fragmented and surrounded by residential development or agricultural land use.

Current land use planning protects some, but not all, of this land from activities which destroy, modify or fragment vegetation. The NPWS has an active role in the local government land use planning process through provision of advice to Council on rezoning and development proposals which effects areas such as these. The NPWS is also involved in threatened species management, through administration of the TSC Act across all land tenures. The NPWS acknowledges the general value of these areas and supports their conservation, but ultimately the responsibility of land management lies with the landowner or relevant authority.

Byron Shire Council has a land use zone for wildlife corridors, called “Environmental Protection - Wildlife Corridors and Environmental Repair” to be added to the Byron LEP. It is intended that existing activities will continue, but when new development applications are lodged, revegetation work could be written into conditions of consent. The system is intended to be continuous with a similar zone in the Tweed Shire (Yeoman, 1999).

Management strategies

i. Undertake appropriate research to identify wildlife corridors which link with the Reserve.

ii. Where appropriate, encourage the conservation of these areas through NPWS Voluntary Conservation Agreements and relevant environmental planning processes.

Desired outcome

(a) To know the location and understand the value of wildlife corridors which adjoin the Reserve, and have put in place a basis on which to work with the community in conserving and restoring these areas.

5.2.4 Fauna release

The Reserve may provide a site for the release of some species of rehabilitated fauna from local carers. The release of local fauna may assist in increasing the genetic diversity and fill niches vacated through local extinctions (A. Benwell pers. comm 1997). However, the release of fauna into the Reserve must be considered carefully in terms of its implications under the NP&W Act and the potential biological impacts associated with the release of fauna. These factors, along with a potentially low survival rate of released fauna (Pietsch 1994; Short and Bradshaw 1992), need to be considered before allowing the release of rehabilitated animals in the Reserve (D. Mackey, pers. comm. 1997).

Management strategy

i. Establish a scientific basis to determine the requirements for the release of rehabilitated wildlife in the Reserve.

Desired outcomes

(a) The release of rehabilitated wildlife into the Reserve will be undertaken on a sound scientific basis.

(b) There will be no unauthorised releases of rehabilitated wildlife into the Reserve.

5.3 Introduced Plants and Animals

5.3.1 Infestations of introduced plants

An introduced plant is defined as any species of plant not native to the local area. Some introduced plant species found in the Reserve (refer to Appendix B) are a legacy of former agricultural land use or mineral sand mining activities (Hogg 1984; Gilmore *et al.* 1986), while others have established through the illegal dumping of garden refuse along the Coast Trail.

Moderate infestations of introduced plants occur in disturbed areas of the Reserve, particularly along the sides of vehicular tracks. Bitou bush (*Chrysanthemoides monilifera rotundata*) is the most widespread, infesting large areas of the foredune and extending inland to the hind dune.

A small cabinet timber plantation in the Reserve contains introduced tree species. The young plantation was established before the land was purchased for reserve dedication. It is of minimal financial and habitat value. Most of the tree species in the plantation are not native to the Reserve.

Introduced plants may threaten cultural sites in the Reserve. For example, many of the middens located on the coastal dune are encroached upon by bitou bush. Similarly, Navin (1990) describes the likelihood of stone artefact scatters becoming lost to a cover of grass and regenerating scrub. The management of cultural sites is discussed in section 5.5.

Management strategies

i. Prevent further dumping of garden refuse and rubbish in the Reserve by restricting public vehicle access, erection of regulatory signage and enforcement of the Regulations (refer to section 7.1).

ii. Remove introduced plant species from the cabinet timber plantation site and promote natural regeneration.

iii. With NPWS supervision and in appropriate situations, encourage the assistance of community groups, such as CONOS, BEACON, South Golden Beach Progress Association, Dunecare and Ocean Shores Primary School, in the removal of introduced plants and subsequent rehabilitation works in the Reserve.

iv. Liaise with the community about the impacts of introduced plants on the heritage values of the Reserve.

Desired outcomes

(a) That there is no dumping of garden refuse in the Reserve

(b) Introduced plants which threaten significant species, communities, habitat or cultural sites are controlled from further invasion, and where possible have been eliminated from the Reserve.

5.3.2 Introduced animals

Introduced animals impact upon native fauna either directly through predation or indirectly through competition for food and shelter. Introduced animals thought to occur in the Reserve include the fox, feral cat, wild dog, feral pigs, feral goats and cane toad. With a fairly large urban area abutting the Reserve, straying domestic cats and dogs are a significant threat to native fauna.

Domestic dogs are also commonly found in the company of people on Crabbes Creek Beach. This beach has been traditionally used by neighbouring residents for recreation and dog exercising. Pursuant to the National Parks and Wildlife Act and Regulations dogs are prohibited in all nature reserves in New South Wales. Prior to the dedication of the Reserve, Byron Shire Council had designated Crabbes Creek Beach as a dog exercise area. With the dedication of the Reserve the designated dog exercising area no longer applies within the Reserve.

Management strategies

i. Provide information to the community about the impacts of straying domestic animals and feral animals on the natural values of the Reserve.

ii. Erect signs advising of the regulations applying to the prohibition of dogs and other domestic animals in the Reserve.

iii. Promote research into the biology and impacts of feral animals in the Reserve.

Desired outcomes

(a) The community is aware of the impact of introduced animals on the natural and cultural heritage values of the Reserve.

(b) Domestic animals do not enter the Reserve.

5.3.3 Pest species management

A plan has been prepared for the rehabilitation of degraded areas and the control of weeds in the Reserve (NPWS 1998). The NPWS will progressively implement the recommendations arising from this plan. No equivalent plan has yet been prepared for introduced animals.

Some introduced species are of concern because of their potential to spread and adversely affect ecological values. These are considered to be pest species.

Some introduced plants have been declared “noxious weeds” under the *Noxious Weeds Act, 1993*. This Act places an obligation on the managers of public lands to control noxious weeds on those lands. Introduced plants including noxious weeds found in the Reserve are listed in Appendix B. A major infestation of the noxious plant groundsel bush (*Baccharis halimifolia*) occurs in the Reserve. A control program has been initiated by the NPWS for this species.

A vigilant and structured approach to the management of pest species is required if the spread of these is to be curtailed. In planning for the management of pest species several issues need to be examined and these include, but are not limited to:

- the presence of noxious weeds;
- habitat and native species directly under threat from invasion or competition;
- methods of eradication to be used;
- ecological impacts of remediation works, and
- duty of care to surrounding community in using control agents.

Management strategies

i. Implement the pest species plan (NPWS 1998), targeting as a priority:
- feral animals which prey upon or compete with species, populations or ecological communities listed as threatened, ROTAP or regionally significant;
- infestations of weeds which threaten the habitat of populations or ecological communities listed as threatened, ROTAP or regionally significant;, and
- noxious weeds which may spread to adjoining properties.

ii. Liaise with the Far North Coast County Council and neighbours on the development and implementation of control programs for pest species in the Reserve.

iii. Undertake measures during pest control programs to protect non-target species.

iv. Utilise best practice methods for spraying activities in the Reserve. Inform neighbours of spraying operations planned for their area.

v. Where necessary, undertake rehabilitation or regeneration works following weed removal or treatment to discourage further weed infestation and prevent soil erosion.

Desired outcomes

(a) To have implemented the pest species control plan for the Reserve.

(b) To have curtailed the spread of noxious weeds.

(c) To have followed best practice in the treatment of pest species in the Reserve.

5.4 Fire

5.4.1 Management obligations

The NPWS recognises that fire is essential for the perpetuation of certain plant and animal species and communities. This ecological requirement needs to be balanced against NPWS's responsibility to protect human life and property. In the Reserve, this is of particular concern because residential properties adjoin the Reserve without fire radiation zones being built into the subdivision design.

Under the *Rural Fires Act 1997,* the NPWS is a fire authority responsible for the suppression and control of fires on the Reserve. The NPWS must ensure fire does not cause damage to adjoining property and is assisted in this task by Byron Shire Fire Brigade, rural fire brigades and in some cases a community fire guard. The NPWS assist the Byron and Tweed Bushfire Management Committees with fire management planning for both Shires. Fire management is a particularly important issue at the Reserve's boundary with residential areas, as urban development has occurred without the inclusion of fire breaks.

The NPWS regards fire as a natural process, one of the abiotic factors of the Australian environment to which native plants and animal communities have adapted. Some species are, however, fire sensitive and these include rainforest associations and coastal cypress pine communities which are found in the Reserve. Areas containing peat may, under certain conditions, be threatened by fire (refer to section 5.1.3). The NPWS also has a responsibility to manage fire for the conservation of natural and cultural heritage under the NP&W Act and the TSC Act.

A draft Fire Management Plan has been prepared for the Reserve and will be placed on public exhibition in 2000.

Management strategies

i. Implement strategies identified in the Fire Management Plan which provides for the protection of adjoining properties as a priority.

Desired outcomes

(a) There is minimal risk of bushfire damage to human life and property.

(b) Fire which originates in the Reserve is contained in the Reserve.

(c) The management and prevention of fire will avoid loss of threatened and significant species, peat deposits or sensitive cultural sites known to occur in the Reserve.

(d) Fire is successfully managed on a scientific basis to enhance habitat values where required.

(e) The peatlands have not been adversely affected by fire.

5.4.2 Fire records

The fire history of Billinudgel Nature Reserve from the time of European settlement to dedication has not been recorded and little of the traditional fire practices of Aboriginal people in the area are understood. It is thought that graziers on the coastal plain may have used fire as a pasture management technique and that Aboriginal people used fire to encourage grazing areas for hunting and corridors for travel. It is likely that traditional fire regimes were quite different to present day regimes.

Recent fire disturbance in the Reserve is minimal compared to other coastal lowland remnants in this region. Anecdotal evidence suggests that only the north-east corner of the Reserve has been subjected to fire in the last 25 years. The most recent of these events occurred in 1981, 1985 and 1992 and were the result of fires deliberately lit along the Central Trail (CONOS, pers. comm., 1997).

The impact of these past events and future fire requirements of plant and animal communities in the Reserve has not yet been investigated.

Management strategies

i. Encourage research into the history of fire in the Reserve.

ii. Maintain records of fire occurrences with particular emphasis on accurate mapping and recording the extent, frequency, seasonality and intensity of fire.

iii. Liaise with neighbouring sugar cane farmers to encourage the green harvesting of cane in an attempt to reduce the risk of cane fires escaping into the Reserve and to minimise runoff and soil erosion from cane fields.

iv. Monitor and record post fire vegetation and fauna responses.

v. Encourage research into fire behaviour, fire hazard and risk assessment, and the impact of fire on the plant and animal communities of the Reserve.

vi. Maintain and upgrade information on fuel characteristics and fire hazard.

Desired outcome

(a) All fire events in the Reserve will be accurately recorded.

5.4.3 Community awareness

A cooperative approach to fire management is integral to its success. Cooperation between the NPWS, brigades, neighbours and other land managers will enable:

- more effective fire management planning;
- more effective wildfire control;
- the occurrence of unplanned fire to be minimised;
- more efficient use of resources; and,
- an increase in the likelihood of achieving the management objectives set out in relevant legislation.

Management strategies

i. Inform and educate the community, especially neighbours, about the role of fire management.

ii. Liaise with relevant landholders regarding fuel reduction activities.

iii. Liaise with Councils, brigades and neighbouring landholders to maintain quick fire response and cooperative fire management arrangements.

iv. Seek cooperation of Councils, brigades and neighbouring landholders to achieve ecologically and socially responsible fire management in the Reserve.

Desired outcome

(a) Fire management in the Reserve is undertaken cooperatively with the neighbouring community.

5.5 Aboriginal Sites

5.5.1 Site disturbance

Many archaeological sites in the region have been disturbed by land uses associated with colonial settlement. Aboriginal sites recorded in the Reserve, such as the bora ring and shell middens, have experienced varying degrees of disturbance and plant invasion. Most disturbance is the result of activities early this century which included logging and clearing, and then mineral sand mining in the

1960s. The larger of the bora rings was breached by a bulldozer during the 1980s as part of a survey associated with a development proposal for the area (Navin 1990).

Management strategies

i. Prepare site management plans for known archaeological sites in consultation with appropriate representatives of the local Aboriginal community.

ii. Aboriginal sites will only be interpreted or publicised with the agreement of representatives of the local Aboriginal community.

iii. Precede all management operations involving land not previously disturbed with an archaeological survey. Relocate, abandon or modify developments to ensure that the cultural heritage of the Reserve is not degraded.

iv. The local Aboriginal community is permitted to carry out cultural activities in the Reserve which are a part of maintaining traditional links to the land. Such activities must comply with the NP&W Act, the objectives and policies of this Plan, have minimal environmental impact and do not involve “taking” from the Reserve.

Desired outcome

(a) Aboriginal sites, places and landscapes of significance are conserved in collaboration with the local Aboriginal community.

5.5.2 Further survey

Navin (1990) identified several zones of high archaeological potential in which sites or artefacts of significance are likely to be found. Further surveys in these areas will establish the presence of sites and enable their protection. Investigation of these areas will also provide further insight into the pattern of habitation of hinterland and coastal areas by Aboriginal people and assist in understanding the cultural landscape. The cultural landscape extends beyond the boundaries of the Reserve and other studies have revealed sites of significance on freehold land adjacent to the Reserve.

Management strategy

i. Undertake further archaeological surveys in areas of the Reserve identified as being of high archaeological sensitivity. Record additional sites and places and determine their management requirements in consultation with the local Aboriginal community.

Desired outcome

(a) Additional archaeological sites have been identified in the Reserve.

(b) There is a greater awareness and understanding of the cultural values of the Reserve by the community.

5.5.3 Management of Aboriginal cultural sites

A legal responsibility for the protection of Aboriginal sites in New South Wales lies with the NPWS. However, the NPWS acknowledges and encourages the right of Aboriginal people to make decisions about their own heritage. The NPWS consults with the Aboriginal community on the management of Aboriginal sites and related issues, and on how Aboriginal culture and history should be promoted and presented to the wider community.

Management strategies

i) Consult and involve the Tweed Byron Local Aboriginal Land Council, the Bundjalung Council of Elders and other relevant Aboriginal community organisations in the management of Aboriginal sites and places of significance occurring in the Reserve. Determine in conjunction with the local Aboriginal community management issues including:
- appropriate level of visitation;
- degree of access to be maintained;
- prescriptions for minimising the risk of site disturbance from management operations, particularly fire control activities;
- long term management of sites undergoing environmental change such as sand drift and regeneration;
- appropriate site management infrastructure, such as fence styles and materials;
- interpretation of Aboriginal culture, and
- weed management needed to protect cultural sites.

ii. Facilitate ongoing communication between the NPWS and the local Aboriginal community with regard to the management of Aboriginal sites within the Reserve.

Desired outcome

(a) There is cooperative and integrated management of Aboriginal places and relics with the Aboriginal community and relevant agencies.

5.6 Management of Historic Sites

There is extensive evidence of past occupation and use in the Reserve, including its past pastoral and diary use, drainage schemes, canal development for residential use which didn't proceed and a relatively recent cabinet timber plantation. The historical significance of the historic sites which remain in the Reserve has not been assessed. Other historic sites may have been destroyed by fire or the elements while others may remain undiscovered.

Management strategies

i. Record and assess the significance of the obvious physical evidence of past occupation and use of the Reserve, such as the dairy ruins and drainage schemes.

ii. Sites, structures and works of potential historic significance will remain undisturbed until an historic assessment has been made and only those assessed as having no historic significance may be removed or disturbed.

iii. Management prescriptions will be developed for all historic sites and relics of significance recorded in the Reserve.

iv. Local historical societies and residents will be encouraged to participate in the recording of the history of the Reserve which may include oral histories and the collection of old photographs.

Desired outcome

(a) Historic sites and relics of significance have been conserved in the Reserve.

6. VISITOR MANAGEMENT: STRATEGIES AND OUTCOMES

Billinudgel Nature Reserve will be managed to ensure that its use, whether by the general public, specialist interest groups, the NPWS or other authorities, is consistent with the NP&W Act, NPWS policy and the objectives of this plan of management.

Uses that may be consistent with a nature reserve include:
- research;
- promotion of, and education about, the area, the NPWS and the conservation of natural and cultural heritage values;
- management operations by the NPWS and other authorities with a statutory responsibility in the area, and
- passive nature based recreation.

6.1 Recreation

6.1.1 Appropriate visitor uses

The natural environment of the Tweed-Byron coast and the relative remoteness of the Reserve and Crabbes Creek Beach make the Reserve an attractive place for recreation. The Reserve is an important recreational resource for residents of North Ocean Shores and South Golden Beach. Visitor numbers are increasing, particularly during holiday periods, from the local area and south-east Queensland, placing significant pressure on the Reserve.

Many of the recreational uses which pre-existed the dedication of the Reserve, such as dog exercising, four-wheel driving, trailbike riding, camping, campfires and the use of firearms, are inconsistent with the purposes of dedication of a nature reserve. Impacts associated with some of these recreational activities include erosion, degradation and destruction of vegetation, bushfires and littering. Fire arm use is illegal and compromises the safety of Reserve visitors and neighbours. Domestic animals are prohibited in the Reserve under the NP&W Act.

The more passive forms of recreation which include sunbathing on the beach, line-fishing from the beach, bush and beach walking and bird watching are consistent with the purpose of dedication of a nature reserve. Activities in the ocean are unaffected by the Reserve.

Management strategies

i. Only passive, nature based recreational activities which are consistent with the purposes of a nature reserve will be permitted in the Reserve. Camping, open fires, public vehicle use and trailbike riding are prohibited uses in the Reserve.

ii. Access points to the Reserve will be clearly sign posted, informing visitors of the relevant regulations which apply to recreational use of the Reserve.

iii. Walkers may use all management trails. Restrictions on use may apply, based on a review of impacts or as a requirement of Reserve management operations.

iv. Off-road use of public vehicles, including trail bikes, is prohibited in the Reserve.

Desired Outcome

(a) That there is a major reduction in the incidence of illegal activities and inappropriate recreational uses occurring in the Reserve.

6.1.2 Special events

Beaches within the region are commonly used for special events such as surf carnivals and fishing competitions. The beach area near the community centre at South Golden Beach is a more appropriate and convenient location for such events, due to access and facilities, but there may be occasions when the beach area of the Reserve is sought for special events which have a nature based focus. Special events will only be permitted on the beach section of the Reserve because of the potential environmental impact of such activities on the Reserve.

The NPWS may license special events to take place on the beach if the event is in accordance with NPWS legislation, policy and the objectives of this plan of management. Licences may include conditions of use.

Management strategies

i. Special events will only be permitted on the beach section of the Reserve.

Desired Outcome

(a) Only appropriate community, public or private special events are permitted to occur in the beach section of the Reserve.

6.1.3 Public access

A vehicular track referred to by the NPWS as the Coast Trail traverses the hind dune parallel to the beach. It extends from the southern boundary of the Reserve through to the northern boundary and is a remnant of mineral sand mining activities along the coast (refer to figure 1, but note that the northern section of the Coast Trail recommended for closure has been deleted from the figure).

The Coast Trail was used as a thoroughfare for vehicles travelling from South Golden Beach to Wooyung, however, the southern and northern sections of the Coast Trail, outside the Reserve boundary, are on private land. The southern section has been closed off and rehabilitated as a result of the Fern Beach estate development.

The Coast Trail, however, was never intended for use as a public roadway and this can be seen in its construction and maintenance. The central section of the Coast Trail is part of the Reserve and has never been a road reserve. Pedestrian access is permitted through the Fern Beach estate onto the Coast Trail, however, the NPWS will negotiate with the landowner/developer to make provision for management and fire vehicles to access through the estate onto the Coast Trail within the Reserve. If this access cannot be negotiated the Coast Trail within the Reserve will be closed and rehabilitated. Walkers wishing to access the Central Trail will then need to do so by walking along Crabbes Creek Beach.

Access for public vehicles through the Reserve, either on the Coast Trail or Jones Road, can have a detrimental effect on the values of the Reserve. Experiencing the highest level of vehicular use, the Coast Trail has encouraged the degradation of the foredune of Crabbes Creek Beach. Radiating out onto the foredune from the Coast Trail is a myriad of smaller sand tracks used for beach access and camping. These tracks have assisted in the widespread destruction and degradation of dune vegetation. These tracks are intrusive on the landscape, cause erosion and turbidity of waters and significantly reduce the quiet enjoyment of the Reserve. For these reasons through access for public vehicles will not be provided in the Reserve.

Tweed Shire Council licenses a set number of four wheel drive vehicles for recreational fishing on Shire beaches. The Reserve is dedicated down to mean low water mark, placing Crabbes Creek Beach within the Reserve (refer to section 3.1). Beach driving in a nature reserve is considered an inappropriate use and contrary to the purposes of dedication of a nature reserve. Consequently private vehicular use on the beach will be prohibited, in the same manner as access trails within the Reserve.

The Coast Trail north to the Central Trail and the return along Crabbes Creek Beach will be promoted as a loop walk extending from the Fern Beach area. The Coast Trail, however, may not be used as a walking track if management vehicle access is not permitted through the Fern Beach development. Should this situation arise the Coast trail will be closed and rehabilitated for its entire length. Other walking track opportunities will be investigated in consultation with the local community, and if considered appropriate and feasible, may be developed in areas of past disturbance. Any other more major proposal, or where the track would traverse relatively undisturbed areas of the Reserve, will require an amendment to this plan.

Through access along Jones Road has been a problem in the past because the central section of the road is low-lying and prone to extended periods of wetness. This section of Jones Road is a public road and is not within the Reserve or jurisdiction of the NPWS. Major damage had occurred to the road surface, making it difficult or impossible to get management and fire vehicles along the road. Jones Road has been recently gated to prevent through access and it is proposed that one additional gate will be installed to keep public vehicles away from the wet section (refer to figure 1).

Landholders on the northern section of Jones Road are, therefore, required to access their property north along Jones Road, part of which has been incorporated into the Reserve (refer to figure 1). Options for affected landholders are being investigated, and if necessary they may be granted access across a small section of

the Reserve (most likely following that section of Jones Road now incorporated into the Reserve), providing this option is legal and minimises environmental damage to the Reserve and vegetated roadsides along Jones Road.

Management strategies

i. Where appropriate work with local government to close the Coast Trail and Jones Road to through public traffic and provide management gates at strategic locations. Sections of the Coast Trail will be rehabilitated (refer to figure 1).

ii. Restrict vehicular access in the Reserve to management vehicles, emergency service vehicles and other relevant authorities or licensed vehicles.

iii. The southern section of the Coast Trail will be available to walkers (as a multi-use trail) to the Central Trail intersection if access for management and fire vehicles is available through Fern Beach estate. If access is denied the Coast Trail will be closed and rehabilitated for its full length through the Reserve.

iv. Private vehicles will be prohibited from driving on the section of Crabbes Creek Beach within the Reserve.

v. The riding of bicycles is prohibited in the Reserve.

vi. Permission may be given on a case by case basis for access of private vehicles undertaking authorised research or Reserve maintenance programs including Dunecare and similar activities.

vii. Subject to a satisfactory environmental assessment, provide a formalised pedestrian access way to the beach at the southern end of the Reserve and opposite the Central Trail (refer to figure 1).

viii. Rehabilitate areas degraded by current access to the beach from the Coast Trail.

ix. Investigate the opportunity and desirability of developing additional walking tracks in the Reserve. If deemed to be feasible in an environmental, social and financial sense, a new walking track may be constructed if it traverses existing areas of disturbance such as old vehicular trails.

x. Access options for landholders who are considered adversely affected by the incorporation of a section of Jones Road into the Reserve will be investigated, with preference given to the option which creates least environmental impact on the Reserve and vegetated roadsides.

Desired outcomes

(a) Appropriate access is provided for nature based recreation, fire protection and reserve management.

(b) There has been a significant reduction in the degradation of the Reserve associated with the use of vehicles and pedestrians.

6.1.4 Visitor facilities

There are currently no visitor facilities in the Reserve. The provision of some day-use facilities is considered desirable for the communities of North Ocean Shores and South Golden Beach (EcoCo-ord 1998), but with the development of the Fern Beach estate there are few viable options left for NPWS near the southern section of the Coast Trail. Facilities may be more appropriately developed at the Community Centre (EcoCo-ord 1998) which already has toilet facilities, car park, outdoor shower and is adjacent to the foreshore.

Additional walking tracks would improve walkers' access through, and enjoyment of, the Reserve (refer to section 6.1.3 and figure 1).

Management strategies

i. Bushwalking opportunities will be improved in the Reserve (refer to section 6.1.3).

ii. No day use (eg. for picnicking) or camping facilities will be provided in the Reserve.

Desired outcome

(a) The adverse environmental impacts of inappropriate recreational use have been reduced in the Reserve.

6.2 Scientific Research and Monitoring

6.2.1 Research requirements

Several areas of future research have been identified in section 3.2.5. The outcomes of this work would assist in developing management prescriptions which ensure the long term conservation of natural and cultural values in the Reserve.

In addition, remnant areas of coastal lowland vegetation such as the Reserve often provide important research opportunities as they contain rare and threatened species and regionally uncommon species or features of special interest.

Management strategies

i. Promote research which may facilitate better management of the Reserve.

ii. Encourage appropriate research by preparing and distributing a prospectus of priority research topics to relevant agencies and tertiary institutions.

iii. Encourage researchers from external organisations to design programs to provide information which is directly useful for management.

iv. Design and implement a Reserve-wide monitoring and review program which assesses the success of implemented key management strategies.

Desired outcomes

(a) Scientific research and monitoring which assists with the conservation of the natural and cultural values has been instigated in the Reserve.

(b) A monitoring program to measure the success of selected key management strategies has been established.

6.2.2 Promotion and Interpretation

Promoting public awareness of the NPWS conservation responsibilities and the natural and cultural values of a protected area is a major aspect of the management of visitor use in parks and reserves in New South Wales. Increased awareness assists in the protection of those natural and cultural values, and increases visitor enjoyment and satisfaction. Interpretative material can also be an important tool in promoting visitor awareness and influencing visitor behaviour.

Themes for interpretation may include:
- coastal landforms and geomorphological processes;
- native plants and animals and the role of the Reserve and surrounding corridors in regional conservation;
- the importance of the cultural values of the Reserve;
- the historical use of the area;
- impacts of former land uses;
- the importance of conserving remnant vegetation for the preservation of natural and landscape values;
- the appropriate recreational use of the Reserve, especially the foreshore; and
- management issues and the purpose of management actions in the Reserve.

There are currently no interpretation displays or publications on the Reserve.

Management strategies

i. Provide interpretation material, including a brochure, for the Reserve.

ii. Provide interpretative signs along walking tracks.

Desired outcome

(a) To have provided interpretative materials which raise the awareness visitors about Reserve values and management.

6.2.3 Other promotion opportunities

Current community interest in a volunteer program could be directed into establishing a “Friends of Billinudgel Nature Reserve” group. This group may be able to raise visitor awareness during peak holiday periods by offering information on the Reserve, its values and management. This group could also become actively

involved in some Reserve management works such as integrated weed control and foredune rehabilitation.

One of the purposes of a nature reserve is to provide for nature based education and the Reserve offers a valuable opportunity to surrounding schools for the study of nature. There is currently limited use of the Reserve by schools.

To assist in implementing many of the management strategies and enhancing the likelihood of achieving both the general and specific management objectives of the Reserve, the NPWS must take an active role in the community with regard to raising awareness of Reserve management programs and activities.

Management strategies

i. Inform neighbours and other community members of management programs being undertaken in the Reserve.

ii. Encourage educational activities by schools, TAFE and Universities which are in accordance with this plan of management, NPWS policy and the purposes of dedication of a nature reserve.

iii. Investigate the opportunity of establishing a “Friends of Billinudgel Nature Reserve” group comprising residents and other interested people assisting District staff with interpretative, weed control, foredune rehabilitation and other relevant programs for the Reserve.

Desired outcome

(a) There is greater community awareness, understanding and appreciation of the natural and cultural values, management and appropriate use of the Reserve.

6.3 Commercial activities.

Crabbes Creek Beach supports a number commercial fishers. Access to the beach by vehicles engaged in commercial fishing operations within the Reserve is largely via informal access points both on and off the Reserve. Vehicles associated with commercial fishing activities may be permitted on the beach within the Reserve but only if licensed by the NPWS. The licences may include conditions of use designed to protect the natural and cultural values of the Reserve.

The current level of degradation and threat of erosion and ocean breakthrough necessitates the closure and rehabilitation of all informal access points to the beach within the Reserve. Commercial fishers will be required to gain entry to Crabbes Creek Beach from access points located outside the Reserve. Beach use will only be permitted for those commercial fishers licensed by the NPWS.

Given the recent and anticipated increase in tourism activity and residential population, the NPWS may be approached by commercial tourism operators regarding activities in the Reserve. Should this be the case, appropriate nature based activities need to be licensed. Activities which are not consistent with the purposes of dedication of a nature reserve will not be permitted.

Management strategies

i. In accordance with NPWS policy, a permit with relevant conditions will be issued for commercial fishers accessing any land within the Reserve, including Crabbes Creek beach, for commercial fishing activities. Some access arrangements and fishing practices may need to be changed to ensure the safety of other beach users and to protect the coastal environment.

ii. Vehicle access for commercial fishers onto the beach will not be provided through the Reserve. Access to the beach from the Coast Trail will not be available for commercial activities. Commercial fishers will need to utilise access points located outside the Reserve.

iii. Ensure that any other commercial activities are controlled and only appropriate activities are licensed.

Desired outcome

(a) All commercial activities are licensed, thereby protecting and conserving the natural and cultural values of the Reserve.

7. MANAGEMENT OPERATIONS: STRATEGIES AND OUTCOMES

7.1 Refuse dumping

Refuse dumping has been identified as one of the most prevalent management issues in the Reserve. In the recent past refuse dumping along the Coast Trail was a significant problem. There have been substantial efforts by the NPWS and the community to clean up refuse along the Coast Trail, however, dumping continues to occur and is highly visible to Reserve visitors. The closure of the Coast Trail to public vehicles (refer to section 6.1.3) will substantially reduce the prevalence of garden refuge and rubbish dumping in the Reserve.

Management strategies

i. Prevent further dumping of garden refuse and rubbish in the Reserve by restricting public vehicle access, erection of regulatory signage and enforcement of the Regulations (refer to section 5.3.1).

ii. Remove, with the assistance of the local community where appropriate, existing refuse from the Reserve.

iii. Participate in community clean-up days which cover the Reserve area.

iv. Prevent unauthorised vehicular use of management trails in the Reserve to reduce the opportunities for further dumping of refuse (refer to section 6.1.3 and 7.3).

v. Erect signs at strategic points along the Reserve boundary advising of regulations regarding refuse dumping in the Reserve.

Desired outcomes

(a) Refuse is removed from the Reserve

(b) There is no further dumping of refuse in the Reserve.

7.2 Non-NPWS Infrastructure

Non-NPWS infrastructure within the Reserve includes two telecommunications cables which are owned by Telstra and Optus. These cables predate Reserve dedication and run underground the length of the Optus Trail and Coast Trail. These cables require a NPWS licence.

Management strategies

i. Licences will be issued to Optus and Telstra for the telecommunication cables located within the Reserve which may include conditions relating to the removal of vegetation and soil disturbance. Any new licence applications will be assessed in accordance with the EPA Act 1979 and NPW Act 1974.

ii. An environmental impact assessment will be required for all proposed developments involving non-NPWS infrastructure within the Reserve.

iii. Non-NPWS infrastructure developments within the Reserve will be prohibited where the proposal may adversely impact on natural and cultural heritage values, conflict with the objectives of this plan of management, or are not consistent with the NP&W Act and NPWS policies.

Desired outcome

(a) No additional non-NPWS infrastructure will be located in the Reserve.

7.3 Management Trails

Vehicular tracks found in the Reserve are a legacy of former land uses and have been incorporated into the Reserve. Of these tracks, the Coast Trail experienced the highest level of use and associated degradation. Restrictions on the use of management trails are recommended (refer to section 6.1.3).

Some vehicular trails will be retained for management purposes while the remainder will be closed to all use and allowed to regenerate. Maintaining vehicular access to the Reserve is particularly important for fire management and protection.

The majority of Jones Road running along the western boundary of the Reserve is a Council public road (refer to figure 1) and is, therefore, not incorporated into the Reserve. Jones Road is mostly gravel, however a section at the foot of Marshalls Ridges is in bad condition becoming impassable in wet weather. It is important that this section of road be protected from degradation given its importance as a fire management trail and as access to neighbouring properties.

Management strategies

i. Within the Reserve, close and allow the regeneration of all vehicular tracks not required for management purposes, including the Coast Trail north of the junction with the Central Trail (refer to figure 1 and further discussion in section 6.1.3).

ii. Liaise with the relevant Shire Council to allow the NPWS to place a locked gate across Jones Road at a point south of the access point into property Portion 34, DP 755721, Parish of Mooball. A second locked gate will be sought near the intersection of Jones Road and the Optus Trail to preclude public vehicles damaging the low-lying section of Jones Road, so that it can be maintained in a condition suitable for fire protection and management vehicles (refer to figure 1).

iii. Upgrade and maintain designated fire trails to NPWS standard for four wheel drive access.

iv. Prohibit unauthorised vehicular and bicycle use of trails within the Reserve. Gate necessary access points to the Reserve to prevent entry of unauthorised vehicles and issue keys to relevant authorities, emergency

services and any neighbour where the only practical or legal access to his/her land is via a locked gate in the Reserve (refer to section 6.1.3 and figure 1).

v. New fire trails identified in the Fire Management Plan may be constructed subject to an appropriate environmental assessment which examines matters such as the potential impact on threatened species and acid sulphate soils.

Desired outcomes

(a) Vehicular access and use in the Reserve is controlled, thereby protecting the natural and cultural values of the Reserve.

(b) An efficient management trail network will be in place in the Reserve for management operations and property protection.

(c) Unnecessary vehicular tracks are closed and rehabilitated.

7.4 Fencing

The Reserve contains sections of fencing which remain from previous agricultural land use. These fences are in a state of disrepair and may injure fauna or impede fire control activities.

New fences are required in areas where livestock stray into the Reserve from neighbouring properties. Only plain wire of an adequate tension should be used wherever possible to protect native fauna from barbed wire related injury.

Management strategies

i. All existing internal fencing will be removed from the Reserve (refer to iii and iv below).

ii. In cooperation with neighbours construct boundary fencing to restrain cattle from entering the Reserve.

iii. Appropriate fencing of rehabilitation sites is permissible but shall be removed upon completion of the rehabilitation project.

iv. Cultural heritage sites may be fenced where required to protect the site.

Desired outcome

(a) Old internal fencing is removed from the Reserve.

(b) Boundary fencing is adequate to exclude stock from entering the Reserve.

7.5 Boundary identification.

The Reserve boundary is not indicated on the ground nor is it easily identifiable from most maps and references. The southern and western boundary are particularly complex (refer to figure 1), adding to the difficulty of determining its location on the ground.

For the purposes of controlling encroachments, managing fire, securing access to the Reserve and general neighbour relations, the boundary requires survey and identification. Permanent boundary markers will eliminate the need to repeat this task. Given the magnitude of surveying the entire boundary, it is proposed that the main points of directional change be identified on the ground as a priority along with other points required for fire management, access, encroachment control or visitor facility purposes.

Management strategies

i. Survey strategic points of the Reserve boundary and indicate major boundary reference points with permanent markers.

ii. Where necessary identify the Reserve boundary for the public through the use of signage.

Desired outcome

(a) The Reserve boundary is clearly identified.

8. PLAN IMPLEMENTATION

This Plan is part of a system of management developed by the NPWS. The system includes the NP&W Act, the NPWS Corporate Plan, field management policies, established conservation and recreation policies, and strategic planning at corporate, Regional and District levels.

The implementation of this plan of management will be undertaken within the annual programs of the NPWS Northern Rivers Region. Priorities are subject to ongoing review within which works and other activities carried out in Billinudgel Nature Reserve are evaluated in relation to Regional and District priorities, specific requirements of the Minister for the Environment or Director-General NPWS and the objectives set out in this plan.

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

In accordance with Section 81 of the NP&W Act, this plan shall be implemented by the Director-General and operations which do not comply with the plan will not be permitted in the Reserve. This plan can be amended in accordance with Section 76(6) of the NP&W Act.

As a guide to the implementation of this plan, priorities for identified activities are provided below. Priorities are determined on the following basis:

High Those strategies which are imperative to the achievement of the management objectives set out in this plan and/or which need to be implemented in the near future on the basis that to not undertake the work will result in:

- unacceptable degradation of the natural and cultural values or physical resources of the planning area;
- contribute significant additional cost associated with rehabilitation at a later date, or
- present an unacceptable risk to public safety.

Medium Those strategies that are necessary to achieve the management objectives set out in this Plan, but will be undertaken as resources become available since the timeframe for their implementation is not so critical.

Low Those strategies which are desirable to achieving the management objectives set out in this Plan, but can wait until resources are available later in the planning period.

The implementation of this plan will be undertaken within the NPWS Northern Rivers Region annual programs. The undertaking of prioritised activities is subject to the availability of necessary staff and funds and to any special requirements of the Director-General or Minister.

The strategies are consistent with resources anticipated to be available to the NPWS over the next five to ten years. Activities which entail a significant financial cost will be included in financial development plans for the Murwillumbah Area commencing from 1999 - 2000. Other activities will be implemented as soon as practicable.

Implementation of key management actions in Billinudgel Nature Reserve

STRATEGY	PRIORITY	PLAN REF
In appropriate locations, undertake works to encourage the accretion of sand and revegetation of native species.	MEDIUM	5.1.1
Influences which may inhibit the natural regeneration of native plant communities, such as weed invasion and wildfire, will be controlled.	HIGH	5.2.1
Investigate the need for active management of forest types to maintain the habitat requirements of threatened or significant species.	MEDIUM	5.2.1
Update and reclassify existing vegetation maps for the Reserve.	HIGH	5.2.1
Undertake appropriate research and determine and implement management prescriptions designed to protect threatened and significant species from threatening processes. Where necessary, restore associated habitat.	MEDIUM	5.2.2
Where appropriate, undertake the restoration of significant vegetation associations including rainforest types which once occurred in the Reserve	LOW	5.2.2
Undertake appropriate research to identify wildlife corridors.	LOW	5.2.3
Establish a scientific basis to determine the requirements for the release of rehabilitated wildlife in the Reserve.	LOW	5.2.4
Prevent further dumping of garden refuse and rubbish in the Reserve by restricting public vehicle access, erection of regulatory signage and enforcement of the Regulations.	HIGH	5.3.1
Remove introduced species from cabinet timber plantation site and promote natural regeneration.	LOW	5.3.1
Erect signs advising of the regulations applying to the prohibition of dogs and other domestic animals in the Reserve.	HIGH	5.3.2
Implement the pest species plan (NPWS 1998), targeting as a priority: - feral animals which prey upon or compete with species, populations or ecological communities listed as threatened, ROTAP or regionally significant; - infestations of weeds which threaten the habitat of populations or ecological communities listed as threatened, ROTAP or regionally significant;, and - noxious weeds which may spread to adjoining properties.	HIGH	5.3.3
Where necessary, undertake rehabilitation or regeneration works following weed removal or treatment to discourage further infestation and prevent erosion.	MEDIUM	5.3.3
Implement strategies identified in the Fire Management Plan which provides for the protection of adjoining properties as a priority.	HIGH	5.4.1
Maintain records of fire occurrences with particular emphasis on accurate mapping and recording the extent, frequency, seasonality and intensity of fire.	LOW	5.4.2
Monitor and record post fire vegetation and fauna responses.	LOW	5.4.2
Liaise with relevant landholders regarding fuel reduction activities.	MEDIUM	5.4.3
Liaise with Councils, brigades and neighbouring landholders to maintain quick fire response and cooperative fire management arrangements.	MEDIUM	5.4.3
Prepare site management plans for known archaeological sites in consultation with appropriate representatives of the local Aboriginal community.	LOW	5.5.1
Undertake further archaeological surveys in areas of the Reserve identified as of high archaeological sensitivity. Record additional sites and places and determine their management requirements in consultation with the local Aboriginal community.	LOW	5.5.2

STRATEGY	PRIORITY	PLAN REF
Record and assess the significance of the obvious physical evidence of past occupation and use of the Reserve, such as the dairy ruins and drainage schemes.	LOW	5.5.4
Access points to the Reserve will be clearly sign posted, informing visitors of the relevant regulations which apply to recreational use of the	HIGH	6.1.1
Close the Coast Trail and other vehicular trails and tracks to public vehicle use and provide locked gates at strategic points.	HIGH	6.1.3
Subject to a satisfactory environmental assessment, provide a formalised pedestrian access way to the beach at the southern end of the Reserve and opposite the Central Trail.	MEDIUM	6.1.3
Rehabilitate areas degraded by current access to the beach from the Coast Trail	MEDIUM	6.1.3
Investigate the opportunity and desirability of developing additional walking tracks in the Reserve. If deemed to be feasible in an environmental, social and financial sense, a new walking track may be constructed if it traverses existing areas of disturbance such as old vehicular trails.	LOW	6.1.3
Design and implement a Reserve-wide monitoring and review program which assesses the success of implemented key management strategies.	MEDIUM	6.2.1
Provide interpretation material, including a brochure, for the Reserve.	MEDIUM	6.2.2
Provide interpretative signs along walking tracks.	MEDIUM	6.2.2
Investigate the opportunity of establishing a " Friends of Billinudgel Nature Reserve" group comprising residents and other interested people assisting District staff with interpretative, weed control, foredune rehabilitation and possibly other programs for the Reserve.	MEDIUM	6.2.3
Prevent further dumping of garden refuse and rubbish in the Reserve by restricting public vehicle access, erection of regulatory signage and enforcement of the Regulations.	HIGH	7.1
Remove, with the assistance of the local community where appropriate, existing refuse from the Reserve.	HIGH	7.1
Prevent unauthorised vehicular use of management trails in the Reserve to reduce the opportunities for further dumping of refuse.	HIGH	7.1
Erect signs at strategic points along the Reserve boundary advising of regulations regarding refuse dumping in the Reserve	HIGH	7.1
Within the Reserve, close and allow the regeneration of all vehicular tracks not required for management purposes, including the Coast Trail north of the junction with the Central Trail.	HIGH	7.3
Liaise with the relevant Shire Council to allow the NPWS to place a locked gate across Jones Road at a point south of the access point into property Portion 34, DP 755721, Parish of Mooball. A second locked gate will be sought near the intersection of Jones Road and the Optus Trail.	HIGH	7.3
Upgrade and maintain designated fire trails to NPWS standard for four wheel drive access.	HIGH	7.3
Prohibit unauthorised vehicular and bicycle use of trails within the Reserve. Gate necessary access points to the Reserve to prevent entry of unauthorised vehicles and issue keys (where necessary).	HIGH	7.3
New fire trails identified in the Fire Management Plan may be constructed subject to an appropriate environmental assessment which examines matters such as the potential impact on threatened species and acid sulphate soils.	HIGH	7.3
All existing internal fencing will be removed from the Reserve.	MEDIUM	7.4
In cooperation with neighbours construct boundary fencing to restrain cattle from entering the Reserve.	MEDIUM	7.4
STRATEGY	**PRIORITY**	**PLAN REF**
Appropriate fencing of rehabilitation sites is permissible but shall be removed upon completion of the rehabilitation project.	LOW	7.4

Survey strategic points of the Reserve boundary and indicate major boundary reference points with permanent markers.	HIGH	7.5
Where necessary identify the Reserve boundary for the public through the use of signage.	LOW	7.5

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Appendix A:
Significant plants and plant communities of Billinudgel Nature Reserve

Table 1: Significant plant species in Billinudgel Nature Reserve

Individual Species	Common name	Significance
Acacia bakeri	marblewood	southern limit of geographical distribution is at the Brunswick River vulnerable - ROTAP
Acronychia baeuerlenii	Byron Bay acronychia	rare - ROTAP / nationally significant
Acronychia littoralis	scented acronychia	restricted distribution / inadequately reserved endangered - ROTAP / nationally significant
Acrostichum speciosum	mangrove fern	large fern uncommon in NSW
Archidendron hendersonii	white lace flower	restricted distribution / southern limit of geographical distribution at Alstonville
Archidendron muellerianum	veiny laceflower	endemic to Mt Warning caldera rare - ROTAP
Argophyllum nullumense	silverleaf	endemic to Mt Warning caldera / conservation important to maintaining genetic diversity of species rare - ROTAP
Banksia ericifolia	heath banksia	northern most occurrence
Banksia robur	large-leaved banksia	disjunct distribution through state / absent south of Billinudgel until reappears at Hat Head NP
Cassia brewsteri var. marksiana		rare - ROTAP
Cordyline congesta	toothed palm lily	rare - ROTAP
Corokia whiteana	corokia	endemic to Mt Warning caldera / considered inadequately conserved / significant as population occurs in littoral rainforest on sand vulnerable - ROTAP
Cupaniopsis newmanii	long leaved tuckeroo	endemic to Mt Warning caldera rare - ROTAP
Davidsonia puriens var. jerseyana	Davidson's plum	disjunct distribution / may be relict population / population reserved in Brunswick Heads also endangered - ROTAP
Drynaria rigidula	Basket fern	Endangered, previously presumed to be extinct in NSW. Three other records in Byron Shire.
Endiandra globosa	black walnut	endemic to eastern Mt Warning caldera / relict distribution similar to Davidson's plum rare - ROTAP
Endiandra hayesii	rusty rose walnut	endemic to Mt Warning caldera / restricted distribution vulnerable - ROTAP
Endiandra sieberi	hard corkwood	restricted food resource in state
Ficus virens	white fig	restricted distribution in NSW/southern limit of geographical distribution at Rous
Leptospermum whitei	white's teatree	restricted distribution in region
Rhodamnia maideniana	smooth leaved rhodamnia	endemic to Mt Warning caldera rare - ROTAP
Syzygium moorei	coolamon tree	endemic to Mt Warning caldera / considered inadequately conserved vulnerable - ROTAP

Sources: Gilmore, *et al,*(1986); Briggs and Leigh (1995); Pressey and Griffith (1987); Balanced Systems Planning (1996); Broadbent and Stewart (1986); Jago (1996); Hogg (1984); NPWS (1987;1989;1990;1995a); Smith (1985); Griffith (pers. comm. to NPWS); Sheringham and Westaway (1995)

ROTAP Denotes authoritative reference on rare and threatened plant species of Australia written by Briggs and Leigh (1995)

Table 2 Significant plant communities in Billinudgel Nature Reserve

Dominant Species	Common name	Community (Gilmore *et al.*, 1986)	Significance
Archontophoenix cunninghamiana	Bangalow palm	swamp rainforest	restricted food resource in state
Callitris columellaris	coastal cypress pine	dry sclerophyll forest/ dune swamp forest ecotone on deep sand	state-wide conservation significance largest stand of mature trees in NSW/ considered inadequately reserved
Cupaniopsis anacardioides - Acronychia imperforata	tuckeroo - beach acronychia	rainforest - in association with frontal dune complex, Pleistocene sand deposits and brushbox gully forests. Bangalow rainforest on edge of paperbark wetland	considered inadequately reserved
Eucalyptus robusta	swamp mahogany	swamp forest/ dune swamp forest ecotone/ floodplain swamp forest ecotone/ dune swamp sclerophyll forest	best developed stand in region / regional nectar source/ considered inadequately conserved north of the Clarence River.
E. pilularis	moist blackbutt	wet sclerophyll forest / dry sclerophyll forest	considered inadequately conserved
E. tereticornis	forest red gum	dry sclerophyll forest	regionally high incidence of clearing/ considered inadequately conserved
E. signata-Banksia aemula - E. intermedia / gummifera	scribbly gum - wallum banksia	dry sclerophyll woodland	rare occurrence in state / association of considerable scientific interest as two species having different soil requirements are not normally found growing together
E. signata- E. intermedia / gummifera	scribbly gum - bloodwood	dry sclerophyll woodland	considered inadequately conserved
Melaleuca quinquenervia	broad leaved paperbark	dune swamp forest ecotone/ floodplain swamp forest ecotone / dune swamp sclerophyll forest/ floodplain swamp sclerophyll forest	regionally high incidence of clearing / regionally inadequate reserve of mature trees established in the absence of fire
Lepironia, Phragmites, Cumbungi , Ferns	semi permanent marshland	fern sedge swamp	regionally rare
Lophostemum confertus	Brushbox	littoral scrub	considered inadequately reserved
Banksia integrifolia ssp.B - Allocasuaria littoralis	coast banksia - black sheoak forest	littoral scrub	considered inadequately represented in the reserve system. Vulnerable to depletion from fire because of sensitivity of *A. littoralis*
Casuarina glauca	swamp oak	regenerating swamp sclerophyll forest	considered inadequately conserved in upper north-east NSW
Lophostemum suaveolens - Eucalyptus robusta - E. resinifera - Melaleuca quinquenervia	swamp turpentine - swamp mahogany - red mahogany - paperbark	Open forest	forest type 68 red mahogany and forest type 30 swamp mahogany are considered poorly conserved
Acronychia imperforata - Euroschinus falcata - Acmena hemilampra	beach acronychia - ribbonwood - lillypilly	littoral rainforest	has prominent rainforest component similar to other gazetted SEPP 26 areas of littoral rainforest

Sources: Gilmore, *et al,*(1986); Pressey and Griffith (1987); Broadbent and Stewart (1986); Hogg (1984); Smith (1985); Hager and Benson (1994); Balanced Systems Planning (1996); Jago (1996); NPWS (1987;1989;1990;1995a); Griffith (1993)

Table 3: Threatened fauna of Billinudgel Nature Reserve

Species	Common name	TSC* list
Crinia tinnula	Wallum froglet	V
Litoria olongburensis	Wallum tree frog	V
Cacophis harriettae	White crowned snake	V
Hoplocephalus stephensii	Stephen's banded snake	V
Esacus neglectus	Beach stone-curlew (thick-knee)	E
Burhinus grallarius	Bush stone-curlew (thick-knee)	E
Calyptorhyncus lathami	Glossy black-cockatoo	V
Charadrius monogolus	Mongolian plover	V
Limicola falcinellus	Broad-billed sandpiper	V
Erythrotriorchis radiatus	Red goshawk	E
Ixobrychus flavicollis	Black bittern	V
Botaurus poiciloptilus	Australasia bittern	V
Anseranas semipalmata	Magpie goose	V
Gallinula olivaceus	Bush-hen	V
Grus rubicunda	Brolga	V
Haematopus fuliginosus	Sooty oystercatcher	V
Haematopus longirostris	Pied oystercatcher	V
Irediparra gallinacea	Comb-crested jacana	V
Lophoictinia isura	Square-tailed kite	V
Monarcha leucotis	White-eared monarch	V
Ninox Strenua	Powerful owl	V
Pandion haliaetus	Osprey	V
Ptilinopus regina	Rose-crowned fruit-dove	V
Ptilinopus superbus	Superb fruit-dove	V
Ptilinopus magnificus	Wompoo fruit dove	V
Tyto novaehollandiae	Masked owl	V
Tyto capensis	Grass-owl	V
Lathamus discolor	Swift parrot	V
Xanthomyza phrygia	Regent honeyeater	E
Ephippiorhynchus asiaticus	Black-necked stork	V
Phascolarctos cinereus	Koala	V
Planigale maculata	Common planigale	V
Potorus tridactylus	Long nosed potoroo	V
Pteropus alecto	Black flying-fox	V
Syconycteris australis	Queensland blossom-bat	V
Saccolaimus flaviventris	Yellow Sheathtail bat	V
Mormopterus norfolkensis	Eastern Little Mastiff-bat	V
Mormopterus beccarii	Beccarri's Mastiff-bat	V
Scoteanax rueppellii	Greater broadnosed bat	V
Chalinolubus nigrogriseus	Hoary bat	V
Kerivoula papuensis	Golden-tipped bat	V
Miniopterus australis	Little bentwing bat	V
Miniopterus schreibersii	Common bentwing bat	V
Nyctophilus bifax	Northern long-eared bat	V

Sources: Jago (1996); Gilmore *et al.* (1986); Balanced Systems Planning (1996); Gilmore, Milledge and Hogan (1985); S Scanlon pers comm; H. James pers. comm.; NPWS database; NPWS 1995 a.

APPENDIX B: WEED SPECIES LIST - BILLINUDGEL NATURE RESERVE

1. TREES and SHRUBS:

Araliaceae	
Schefflera actinophylla	Umbrella Tree
Arecaceae	
Phoenix dactylifera	Date Palm
Syagrus romanzoffianum	Cocos Palm
Asteraceae	
Baccharis halimifolia	Groundsel Bush
Chrysanthemoides monilifera ssp. *rotundata*	Bitou Bush
Fabaceae	
Acacia podalyriifolia	Queensland Silver Wattle
Erythrina crista-galli	Coral Tree
S. x *floribunda*	Smooth Senna
Senna pendula var. *glabrata*	Winter Senna
Lauraceae	
Cinnamomum camphora	Camphor Laurel
Moraceae	
Morus alba	Mulberry
Myrtaceae	
Leptospermum laevigatum	Coast Teatree
Oleaceae	
Ligustrum sinense	Small-leaved Privet
Pinaceae	
Pinus sp.	Pine
Rutaceae	
Citrus limonia	Bush Lemon
Solanaceae	
Solanum mauritianum	Wild Tobacco
Verbenaceae	
Lantana camara	Lantana

2. VINES and SCRAMBLERS:

Acanthaceae	
Thunbergia alata	Black-eyed Susan
Asclepiadaceae	
Araujia sericifera (A. sericiflora)	Moth Vine
Colchicaceae	
Gloriosa superba	Glory Lily
Convolvulaceae	
Ipomoea cairica	Coastal Morning Glory
Fabaceae	
Desmodium uncinatum	Silver-leaf Desmodium
Macroptilium atropurpureum	Siratro

Passifloraceae

Passiflora edulis	Edible Passionfruit
P. suberosa	Corky Passionfruit
P. subpeltata	White Passionflower

3. HERBS and GROUNDCOVERS:

Acanthaceae

Hypoestes phyllostachya	Freckle Plant

Asparagaceae

Asparagus aethiopicus (Protasparagus aethiopicus)	Ground Asparagus

Asteraceae

Ambrosia artemisiifolia	Annual Ragweed
Ageratina adenophora	Crofton Weed
A. riparia	Mist Weed

Balsamaceae

Impatiens walleriana	Busy Lizzie

Cannaceae

Canna indica	Canna

Dracaenaceae

Sansevieria trifasciata	Mother-in-law's Tongue

Onagraceae

Oenethera sp.	Evening Primrose

Poaceae

Melinus minutiflora	Molasses Grass
Paspalum wettsteinii	Broad-leaf Paspalum
Setaria sp.	Setaria

4. FERNS:

Davalliaceae

Nephrolepis cordifolia	Fishbone Fern

Additional grasses and annuals

From Joseph (1998).