NSW GOVERNMENT
Environment, Climate Change & Water
National Parks & Wildlife Service

Marshalls Creek Nature Reserve

Plan of Management

MARSHALLS CREEK NATURE RESERVE

PLAN OF MANAGEMENT

NSW National Parks and Wildlife Service

Part of the Department of Environment, Climate Change and Water

February 2011

This plan of management was adopted by the Minister for Climate Change and the Environment on 21st February 2011.

Acknowledgments

The NPWS acknowledges that this reserve lies within the traditional country of the Bundjalung Aboriginal people.

This plan of management is based on a draft plan prepared by staff of the Northern Rivers Region of the NSW National Parks and Wildlife Service (NPWS), part of the Department of Environment, Climate Change and Water.

Valuable assistance including information and comments were also provided by the Northern Rivers Regional Advisory Committee and NPWS specialists.

Cover photographs: Marshalls Creek by Lori Cameron, NPWS. Sacred Kingfisher by Surfland Photography.

For additional information or any inquiries about Marshalls Creek Nature Reserve or this plan of management, contact the NPWS Tweed Area Office, Level 1, 135 Main Street Murwillumbah NSW 2484 or by telephone on (02) 6670 8600.

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FOREWORD

Marshalls Creek Nature Reserve is located approximately 45 kilometres north of Byron Bay on the far north coast of New South Wales.

The reserve conserves significant coastal vegetation including mangroves, saltmarsh and swamp forest communities, as well as sclerophyll forest and several patches of littoral rainforest. Eleven plant species and 24 animal species which are classified as endangered or vulnerable have been recorded in the reserve.

The reserve includes much of the lower estuarine section and floodplains of Marshalls Creek, which is the north arm of the Brunswick River. It adjoins the Cape Byron Marine Park.

The reserve lies within the area traditionally occupied by the Minjungbal people of the Bundjalung nation.

The New South Wales *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 an area will be managed in the years ahead.

A draft plan of management for Marshalls Creek Nature Reserve was placed on public exhibition from 29th August until 1st December 2008. The submissions received were carefully considered before adopting this plan.

This plan contains a number of actions to achieve the State Plan priority to "Protect our native vegetation, biodiversity, land, rivers and coastal waterways", including implementation of strategies for the recovery of threatened species, control of pest species, implementation of the fire management strategy for the reserve.

This plan of management establishes the scheme of operations for Marshalls Creek Nature Reserve. In accordance with section 73B of the *National Parks and Wildlife Act 1974,* this plan of management is hereby adopted.

Frank Sartor MP
Minister for Climate Change and the Environment

1. MARSHALLS CREEK NATURE RESERVE

Marshalls Creek Nature Reserve (hereafter referred to as "the reserve") is located approximately 45 kilometres south of Tweed Heads and 20 kilometres north of Byron Bay on the far north coast of New South Wales (NSW). The reserve abuts the coastal townships of Ocean Shores, New Brighton and South Golden Beach, which have a combined population of approximately 6000 (refer to Figure 1: Map of Marshalls Creek Nature Reserve).

The reserve lies within the area traditionally occupied by the Minjungbal people of the Bundjalung nation. The Tweed Byron Local Aboriginal Land Council and the Bundjalung Council of Elders are the main consultative groups representing the Aboriginal community on cultural heritage management issues within the reserve.

The original area of the reserve, comprising 112 hectares of high conservation value vacant Crown land, was gazetted in 1999 as part of the Upper North East NSW Regional Forestry Agreement process. A Compensatory Habitat Package was negotiated between the Department of Environment and Climate Change and the Roads and Traffic Authority (RTA) for impacts associated with the Brunswick Heads to Yelgun Pacific Highway upgrade. Through this process a further 40 hectares of freehold land between Shara Boulevard and Balemo Drive was added to the reserve in 2007 and 2008. The total area of the reserve is currently 152 hectares.

The reserve adjoins Billinudgel Nature Reserve to the north and Brunswick Heads Nature Reserve to the south. These reserves and other coastal reserves in the nearby area including Tweed Estuary, Ukerebagh, Cudgen, Wooyung and Tyagarah Nature Reserves protect significant coastal vegetation, wildlife habitat and corridors.

The reserve features vegetation communities indicative of the extent and frequency of tidal flooding including mangroves, saltmarsh and *Casuarina* forest. The reserve also protects swamp forest communities, sclerophyll forest and rainforest.

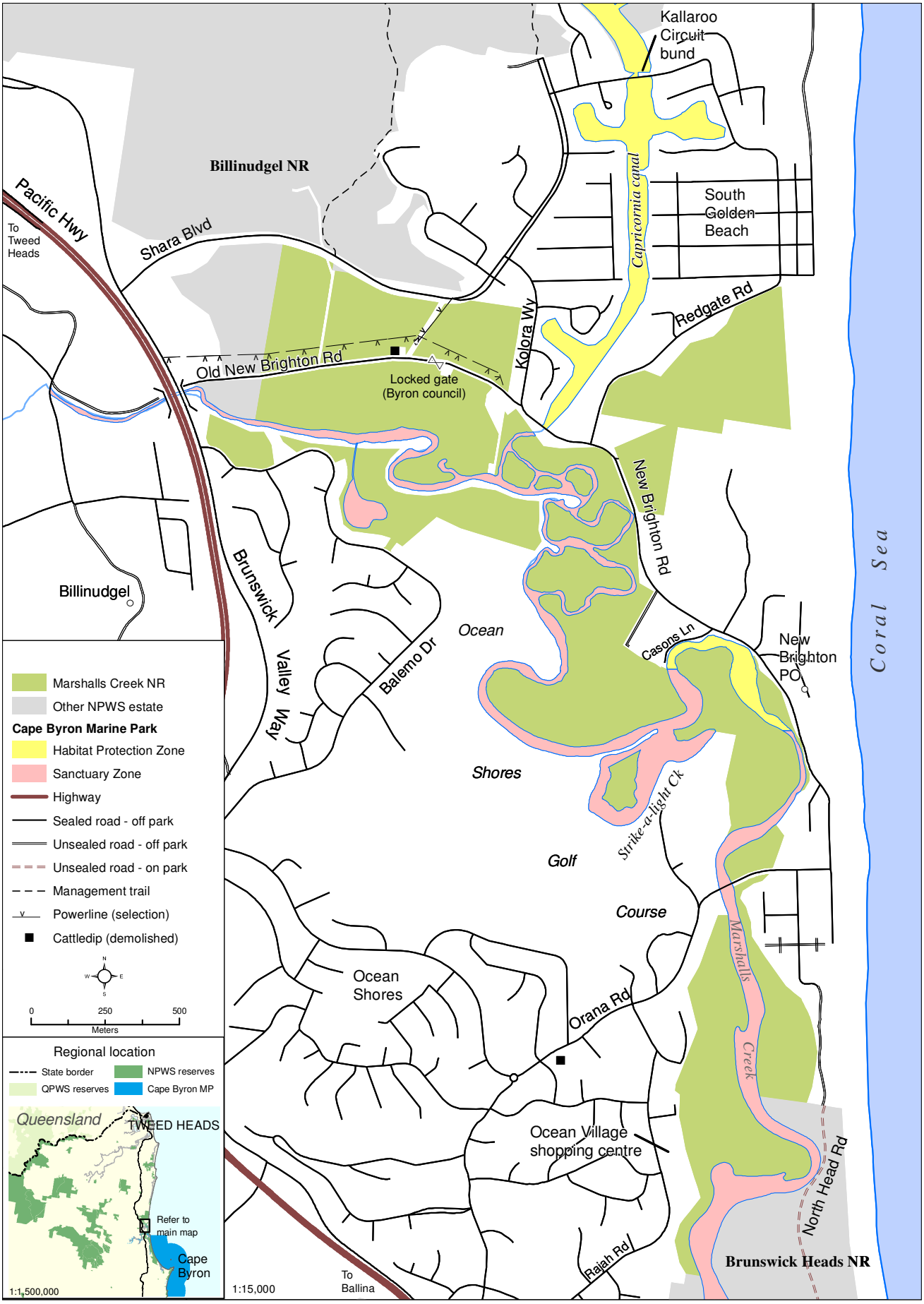
The reserve lies within the biogeographical province known as the Macleay-McPherson Overlap Zone (Burbidge 1960 cited in NPWS 2000) which extends roughly from the Queensland border to the Hunter Valley in NSW. Being a transitional area subtropical and temperate species of flora and fauna coexist, and many species find their southern or northern distribution limits respectively within this zone (Lott and Duggin 1993). The climate is coastal subtropical. Generally, almost 70% of the year's average rainfall of 1650 millimetres falls from middle to late summer.

The reserve extends to the mean low watermark and includes much of the lower estuarine section and floodplains of Marshalls Creek, which is the north arm of the Brunswick River. The tidal waters and tidal lands to the mean high water mark of Marshalls Creek, including its creeks, bays and tributaries, are within the Cape Byron Marine Park (refer to Figure 1: Map of Marshalls Creek Nature Reserve) resulting in the intertidal zone being both nature reserve and marine park. The Zoning Plan for the Marine Park came into effect on 1 May 2006. The NPWS and Marine Parks Authority (MPA) aim to ensure that management of the reserve and the Marine Park is compatible.

The reserve is in Byron Shire within close proximity to urban development. Tourism, commercial fishing, beef production, dairy farming and banana cultivation are the major industries in the area.

The Byron Shire Council's Estuary Management Committee has supervised the preparation of the Brunswick Estuary Management Plan (Patterson, Britton and Partners 2008). The Estuary Management Plan encompasses the tidal reaches of the Brunswick River, Kings Creek, Simpsons Creek and Marshalls Creek. It identifies key management issues, objectives and measures to maintain or improve the environmental and community values of the estuary. NPWS is represented on the Management Committee.

Figure 1: Map of Marshalls Creek Nature Reserve



2. MANAGEMENT CONTEXT

2.1 Legislative and Policy Framework

The management of nature reserves in NSW is in the context of a legislative and policy framework, primarily the *National Parks and Wildlife Act 1974* (NPW Act), the *National Parks and Wildlife Regulation 2002*, the *Threatened Species Conservation Act 1995* (TSC Act) and the policies of the National Parks and Wildlife Service (NPWS). Section 72AA of the NPW Act lists the matters to be considered in the preparation of a plan of management. The policies are based on the legislative background and internationally accepted principles of park management. They relate to nature conservation, Aboriginal and historic heritage conservation, recreation, commercial use, research and communication.

Other legislation, international agreements and charters may also apply to management of the area. In particular, the *Environmental Planning and Assessment Act 1979* (EPA Act) may require the assessment and mitigation of the environmental impacts of works proposed in this plan. In addition, Marshalls Creek up to the mean high water mark is part of Cape Byron Marine Park (refer to Figure 1: Marshalls Creek Nature Reserve) and is also managed in accordance with the *Marine Parks Act 1997* and *Marine Parks Regulation 1999.*

A plan of management is a statutory document under the NPW Act. Once the Minister has adopted a plan, no operations may be undertaken within Marshalls Creek Nature Reserve except in accordance with this plan. This plan will also apply to any future additions to Marshalls Creek Nature Reserve. Where management strategies or works are proposed for the reserve or any additions that are not consistent with the plan, an amendment to the plan will be required.

2.2 Management Purposes and Principles

Nature reserves are reserved under the NPW Act to protect and conserve areas containing outstanding, unique or representative ecosystems, species, communities or natural phenomena.

Under the Act (section 30J), nature reserves are managed to:

- conserve biodiversity, maintain ecosystem functions, and protect geological and geomorphological features and natural phenomena;
- conserve places, objects, features and landscapes of cultural value;
- promote public appreciation, enjoyment and understanding of the reserve's natural and cultural values; and
- provide for appropriate research and monitoring.

Nature reserves differ from national parks in that they are not required to provide for visitor use as a management principle.

2.3 Management Directions

Marshalls Creek Nature Reserve will be managed to conserve its natural and cultural heritage values. Encouraging visitor use that is compatible with and promotes understanding of these values is also a priority. These objectives will be achieved through the following actions:

- Management of the reserve as part of a regional network of coastal and estuarine reserves;

- Recognition and protection of the traditional and contemporary Aboriginal cultural heritage values in partnership with the local Aboriginal community;

- Conservation and rehabilitation of the diversity of habitats and threatened species within the reserve, with emphasis on the protection and rehabilitation of wetland habitat through control of introduced species and exclusion of fire;

- Maintenance of a hydrological regime that allows natural erosion, accretion and hydrological processes to continue;

- Management of the reserve for low impact, self-reliant recreation and scientific investigation, consistent with its values, nature reserve classification and management of the adjoining Cape Byron Marine Park; and

- A cooperative approach with other agencies, adjoining lands managers, neighbours and other relevant parties to ensure effective, efficient and cooperative management of the reserve.

3. VALUES OF THE RESERVE

The location, landforms and plant and animal communities of an area determine how it has been used and valued. Both Aboriginal and non-Aboriginal people place values on natural areas, including aesthetic, social, spiritual and recreational values. These values may be attached to the landscape as a whole or to individual components, for example to plant and animal species used by Aboriginal people.

The Tweed-Byron coast was, and to a lesser extent remains, an important area of exploitation, occupation and access for Aboriginal people due to the richness of plant and animal resources found in the coastal waterways, surrounding flood plains and forests.

European land uses since the 1840s such as timber harvesting, cattle grazing, dairy farming, sugarcane production, sand mining, fishing, oyster farming and urban development have had varying degrees of impact on the surrounding landscape. Since the 1920s extensive canals and levees were developed near the reserve for the drainage of wetland areas.

The remnant vegetation in the reserve including significant wetlands, littoral rainforest, mangroves and swamp forest communities provide habitat for Endangered Ecological Communities and species listed as endangered or vulnerable under the *Threatened Species Conservation Act 1995*. The remnant vegetation in the reserve also provides significant habitat corridors linking with other coastal reserves and provides foraging and roosting habitat for many species of migratory and resident shorebirds.

This plan of management aims to conserve both natural and cultural values. For reasons of clarity and document usefulness, natural heritage, cultural heritage, threats and on-going use are dealt with individually, but their inter-connectedness is recognised.

3.1 Landform, Geology and Soils

Landforms represented in the reserve include coastal sandplains, coastal floodplains and sub-coastal hills. These landforms reflect a complex history of coastal erosion and depositional processes associated with sea level fluctuations and glaciation throughout the Pleistocene period (Navin 1990).

Coastal sandplains dominate the northern section of the reserve and characterise much of the barrier dune environment to the east. The gently undulating sand plains are essentially sediment basins created by the gradual infilling of the old barrier estuary. They contain unconsolidated sediments of Quaternary estuarine alluvium overlain by and/or mixed with Pleistocene aeolian sands originating from the adjacent coastal dune complex. This has produced poorly-drained podzols and acid peat soils with characteristically high water tables (Morand 1994).

Coastal floodplains in the form of tidal flats dominate much of the central and southern sections of the reserve. These estuarine landforms have been formed primarily by tidal channel action and are comprised of unconsolidated Quaternary estuarine and alluvial sediments. The floodplain is subject to varying degrees of tidal influence, resulting in four parallel zones of inundation; mudflats, mangroves, saltmarsh, and low closed littoral forest. The mudflat and mangrove zones feature soils comprised of deep waterlogged siliceous sands and solonchaks, whilst saltmarsh and littoral forest areas have a waterlogged and highly acidic humic gley (grey clay) subsoil overlain by highly organic or peaty topsoil. Areas removed from tidal influences have formed freshwater swamps (Morand 1994).

The basement rocks of the Byron Coast are Palaeozoic metamorphosed sediments of the Neranleigh-Fernvale Group comprised of siltstones and mudstones with occasional larger units of sandstone and conglomerate. This geology is exemplified by erosional landforms such as the sub-coastal hills characterising much of the adjacent residential area of Ocean Shores, with limited occurrences along the south-western edge of the reserve. The weathering of these rocks has produced well-drained deep yellow and red podzolic soils, which occur intermittently along the Byron Coast where they have been exposed at the base of the coastal escarpment (Landmark *et al* 1999; Morand 1994).

Marshalls Creek originates 1.5 kilometres east of the village of Main Arm at an elevation of approximately 100 metres and meanders for a total of 23 kilometres before joining the Brunswick River. The creek flows eastward through a valley bound by ridges to the north and south, draining elevated and low-lying areas of vegetated and cleared land, as well as Lacks Creek which drains an adjacent valley to the north. The lower reaches of Marshalls Creek, 8 kilometres of which adjoin the reserve, also receive runoff from elevated terrain within the village of Ocean Shores, and low lying areas with poor drainage including the Billinudgel floodplain and the South Golden Beach residential development. The latter areas drain into Marshalls Creek via the Capricornia Canal, a large artificial canal built in 1974. Strike-a-Light Creek, which is just outside the reserve near the New Brighton Post Office, and a large modified tidal lake near Balemo Drive both drain into Marshalls Creek.

The sandy beaches adjacent to the reserve, typical of the northern NSW coastline, are dynamic sedimentary systems that naturally experience phases of erosion. Natural erosion mostly occurs during seasonal storms, but can be exacerbated by coastal development modifications to the shoreline configuration, such as breakwaters, groynes and retaining walls. Sediment transport pathways can also be disrupted, thus increasing susceptibility to erosion as sediment loss exceeds delivery (NPWS 2000; Marine Parks Authority 2003).

In the 1960s sandmining occurred along the NSW north coast and although confined to beaches, also resulted in disturbance to the hind dunes through road construction and exposure of the vegetation on the north-eastern boundary of the reserve to salt laden winds.

3.2 Native Flora

The reserve features a diverse range of vegetation species and communities that reflect environmental conditions associated with hydrology and tidal inundation, soil type and drainage, fire history, degree of exposure to saline conditions, and community succession in response to past disturbance.

Infrequent tidal inundation and poor drainage promotes the dominance of swamp sclerophyll communities on floodplain areas inland of mangrove communities. In contrast to other vegetation types in the reserve, the swamp sclerophyll communities remain largely undisturbed having escaped development due to waterlogging and flood-prone ground conditions.

Flora surveys were undertaken in the area in 1992 as part of an investigation for proposed additions to the NPWS reserve system (Benwell, 1992). Aerial Photographic Interpretation (API) was used to map broad vegetation types and eucalypt growth stage in the reserve for the Byron Flora and Fauna Study (Landmark *et al* 1999) and the Comprehensive Regional Assessment Aerial Photographic Interpretation (CRAFTI) Project (NPWS 2001). Field work from projects such as these as well as incidental observations have contributed to the understanding of vegetation types in the reserve. However, a systematic flora survey of the whole reserve has not been undertaken.

The reserve supports significant remnant coastal and estuarine vegetation communities of state and regional significance due to their restricted distribution and poorly conserved status (Landmark *et al* 1999; NPWS 1995 in NPWS 2000). These include coastal wetlands (SEPP 14) and littoral rainforest (SEPP 26). Several plant communities found in the reserve, such as North Coast NSW Coastal Saltmarsh and Littoral Rainforest, are also listed as Endangered Ecological Communities (EECs) under the TSC Act. Other North Coast Bioregion EECs found in the reserve include: Subtropical Coastal Floodplain Forest; Swamp Oak Floodplain Forest; Lowland Rainforest on Floodplain; and Swamp Sclerophyll Forest on Coastal Floodplains.

Grey mangrove *(Avicennia marina* subsp. *australasica)* and river mangrove *(Aegiceras corniculatum)* dominate the saline wetland communities in the reserve, with milky mangrove (*Excoecaria agallocha*) and cottonwood hibiscus (*Hibiscus tiliaceaus*) occurring on the inland margins. Estuarine complexes containing a range of herb, sedge and grassland species such as bare twig-rush (*Baumea juncea*), mangrove fern (*Acrotichum speciosum*) and common reed (*Phragmites australis*) occur in moist locations throughout the reserve. Substantial areas of saltmarsh also occur in the Marshalls Creek estuary.

Low closed littoral forest communities dominated by swamp oak (*Casuarina glauca*) tend to occupy narrow fringes being replaced by, or co-dominant with, broad-leaved paperbark (*Melaleuca quinquenervia*) further inland where conditions are less saline. Swamp mahogany (*Eucalyptus robusta*) also occurs in these areas. The paperbark forests are significant because they occupy a large part of the reserve. Paperbarks flower in winter providing a vital seasonal food source for nectivorous fauna. Both the estuarine and swamp sclerophyll communities within the reserve have been recognised for their significance as SEPP 14 Coastal Wetlands.

More elevated areas of the floodplain are vegetated with wet or dry sclerophyll forest containing a mixture of eucalypt species, much of which is old growth. These communities are significant as the only example of old growth mixed eucalypt forest on alluvial soils recorded in the Byron Local Government Area (Landmark *et al* 1999). Old growth forests contain hollow-bearing trees, particularly eucalypts and related species, which provide critical habitat for many native and threatened fauna.

The dry sclerophyll communities are generally dominated by forest red gum (*Eucalyptus tereticornis*) and pink bloodwood (*Corymbia intermedia*), with a small occurrence of blackbutt (*Eucalyptus pilularis*) dominated forest occurring in the north-western part of the reserve. Closer to the coast, the dry sclerophyll forest is dominated by coastal wattle (*Acacia longifolia* subsp. *sophorae*) and coast banksia (*Banksia integrifolia* subsp. *integrifolia*) with infestations of bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*).

Moist coastal and wet sclerophyll forest within the reserve feature associations of forest red gum (*Eucalyptus tereticornis*), flooded gum (*Eucalyptus grandis*) and brush box (*Lophostemon confertus*) with occurrences of forest oak (*Allocasuarina torulosa*), tallowwood (*Eucalyptus microcorys*) and red mahogany (*Eucalyptus resinifera*).

The reserve contains areas of ecotonal vegetation where community types intersperse or overlap. This is indicated by the presence of rainforest elements such as blackwood (*Acacia melanoxylon*), red ash (*Alphitonia excelsa*) and guioa (*Guioa semiglauca*) in moister vegetation types throughout the reserve, such as wet sclerophyll and swamp sclerophyll forest. Ecotones are structurally complex zones which provide a variety of resources for a range of fauna, as well as assisting faunal movement throughout the reserve (Gilmore *et al*. 1986 cited in NPWS 2000).

The reserve contains several patches of littoral rainforest, some of which are part of larger areas of mapped SEPP 26 littoral rainforest that also cover adjoining freehold land. In the southern and north-western parts of the reserve the littoral rainforest is dominated by hoop pine (*Araucaria cunninghamii*) with cottonwood hibiscus (*Hibiscus tiliaceus*) bordering mangrove areas. Bangalow palm (*Archontophoenix cunninghamiana*) occurs in moister locations.

The NPWS Atlas of NSW Wildlife database lists 11 flora species recorded in the reserve which are classified as endangered or vulnerable under the TSC Act. Eight of these species are also listed as threatened on the national level under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Refer to Table 1.

Table 1: Threatened flora recorded in Marshalls Creek Nature Reserve

Common Name	Scientific Name	TSC Status	EPBC Status
Corokia	*Corokia whiteana*	Vulnerable	Vulnerable
Crystal Creek walnut	*Endiandra floydii*	Endangered	Endangered
Davidson's plum	*Davidsonia jerseyana*	Endangered	Endangered
Durobby	*Syzygium moorei*	Vulnerable	Vulnerable
Marblewood	*Acacia bakeri*	Vulnerable	NA
Red lilly pilly	*Syzygium hodgkinsoniae*	Vulnerable	Vulnerable
Scented acronychia	*Acronychia littoralis*	Endangered	Endangered
Stinking cryptocarya	*Cryptocarya foetida*	Vulnerable	Vulnerable
White lace flower	*Archidendron hendersonii*	Vulnerable	NA
White yiel yiel	*Grevillea hilliana*	Endangered	NA
Yellow satinheart	*Bosistoa transversa*	Vulnerable	Vulnerable

Under the TSC Act recovery plans may be prepared for threatened species, populations or ecological communities. Additionally a threatened species Priorities Action Statement (PAS) has been prepared that outlines the broad strategies and detailed priority actions to promote the recovery of threatened species, populations and endangered ecological communities and to manage key threatening processes. The PAS and recovery plans will be used to guide management of threatened species in the reserve.

Final recovery plans for *Endiandra floydii* (Crystal Creek walnut) and *Davidsonia jerseyana* (Davidson's plum) have been approved. Recovery actions are included in the PAS for all species listed in table 1 except for red lilly pilly and white yiel yiel.

3.3 Native Fauna

The reserve provides vegetated links between forested areas along the coast as well as connecting coastal lowland and hinterland forests. This enables the movement of nomadic and migratory animal species and helps to maintain the diversity and long term viability of local and regional native fauna. Areas of native vegetation on private lands that adjoin the reserve constitute an important part of this corridor system (Gilmore *et al.* 1986 cited in NPWS 2000).

A systematic fauna survey of the whole reserve has not been undertaken. However, plot-based data have been recorded in the reserve as part of larger projects such as the Vertebrates of Upper North East NSW surveys for the Natural Resources Audit Council (NPWS 1995b) and the Byron Flora and Fauna Study (Landmark *et al* 1999).

The NPWS Atlas database lists 167 native fauna species recorded in or adjacent to the reserve, 24 of which are classified as endangered or vulnerable under the TSC Act (refer to Table 2). Four of these species are also listed as threatened under the EPBC Act. Given the

diversity of vegetation and habitat types in the reserve, and that 44 species of threatened fauna have been recorded in the adjoining Billinudgel Nature Reserve, a systematic fauna survey of the reserve is likely to result in new fauna and threatened species records.

Table 2: Threatened fauna recorded in Marshalls Creek Nature Reserve

Common Name	Scientific Name	Status
Barred cuckoo-shrike	*Coracina lineata*	Vulnerable
Beach stone-curlew	*Esacus neglectus*	Endangered
Black bittern	*Ixobrychus flavicollis*	Vulnerable
Black-necked stork	*Ephippiorhynchus asiaticus*	Endangered
Brolga	*Grus rubicunda*	Vulnerable
Bush stone-curlew	*Burhinus grallarius*	Endangered
Collared kingfisher	*Todiramphus chloris*	Vulnerable
Glossy black-cockatoo	*Calyptorhynchus lathami*	Vulnerable (E)
Little tern	*Sterna albifrons*	Endangered
Magpie goose	*Anseranas semipalmata*	Vulnerable
Mangrove honeyeater	*Lichenostomus fasciogularis*	Vulnerable
Osprey	*Pandion haliaetus*	Vulnerable
Pied oystercatcher	*Haematopus longirostris*	Vulnerable
Regent honeyeater	*Xanthomyza phrygia*	Endangered (E)
Sooty oystercatcher	*Haematopus fuliginosus*	Vulnerable
Sooty tern	*Sterna fuscata*	Vulnerable
Square-tailed kite	*Lophoictinia isura*	Vulnerable
Swift parrot	*Lathamus discolor*	Endangered (E)
White tern	*Gygis alba*	Vulnerable
Wompoo fruit-dove	*Ptilinopus magnificus*	Vulnerable
Eastern bentwing-bat	*Miniopterus orianae* subsp. *oceanensis*	Vulnerable
Grey-headed flying-fox	*Pteropus poliocephalus*	Vulnerable (V)
Koala	*Phascolarctos cinereus*	Vulnerable
Large-footed myotis	*Myotis macropus*	Vulnerable
Little bentwing-bat	*Miniopterus australis*	Vulnerable

(E) = endangered under EPBC Act; (V) = vulnerable under EPBC Act.

In accordance with the TSC Act, Priorities Action Statements and recovery plans will be used to guide management of threatened species in the reserve. Final recovery plans for the koala and little tern have been approved. Recovery actions are included in the PAS for all of the species listed in table 2 with the exception of the mangrove honeyeater.

The old growth forest in the eucalypt communities of the reserve is important for many specialised species, particularly those dependent on hollows. These forests are also important for other threatened species such as the koala. The rainforest or mesic vegetation elements associated with the paperbark (*Melaleuca quinquenervia*) - swamp mahogany (*Eucalyptus robusta*) forests within the reserve are of high value for rainforest fauna. The majority of the reserve is narrow and fragmented by residential development, therefore links to other vegetated areas such as nearby NPWS estate and Marshalls Ridges are essential as wildlife corridors.

The intertidal sand and mudflats in the lower reaches of Marshalls Creek provide important foraging and roosting habitat for many species of migratory and resident shorebirds including pied and sooty oystercatchers, grey-tailed tattlers and bar-tailed godwits. Several bird species in the reserve are protected under international agreements, such as the Japanese and Australian Migratory Bird Agreement (JAMBA) and/or the Chinese and Australian Migratory Bird Agreement (CAMBA) (refer to Table 3). Mangrove habitat within the creek is utilised by numerous species of passerine and non-passerine birds for roosting, foraging and breeding (Marine Parks Authority 2003).

Table 3: Bird species protected by international agreements recorded in Marshalls Creek Nature Reserve

Common Name	Scientific Name	CAMBA	JAMBA
Bar-tailed godwit	*Limosa lapponica*	Yes	Yes
Common greenshank	*Tringa nebularia*	Yes	Yes
Common sandpiper	*Actitis hypoleucos*	Yes	Yes
Common tern	*Sterna hirundo*	Yes	Yes
Eastern curlew	*Numenius madagascariensis*	Yes	Yes
Eastern reef egret	*Egretta sacra*	Yes	No
Great egret	*Ardea alba*	Yes	Yes
Great frigatebird	*Fregata minor*	Yes	Yes
Grey-tailed tattler	*Heteroscelus brevipes*	Yes	Yes
Latham's snipe	*Gallinago hardwickii*	Yes	Yes
Lesser frigatebird	*Fregata ariel*	Yes	Yes
Lesser golden plover	*Pluvialis dominica*	Yes	Yes
Little tern*	*Sterna albifrons*	Yes	Yes
Ruddy turnstone	*Arenaria interpres*	Yes	Yes
Short-tailed shearwater	*Puffinus tenuirostris*	No	Yes
Whimbrel	*Numenius phaeopus*	Yes	Yes
White-bellied sea-eagle	*Haliaeetus leucogaster*	Yes	No
White-throated needletail	*Hirundapus caudacutus*	Yes	Yes

* Also listed as endangered under the TSC Act

3.4 Aboriginal Heritage

Aboriginal communities have an association with and connection to the land. The land and water biodiversity values within a landscape are central to Aboriginal spirituality and contribute to Aboriginal identity. Aboriginal communities associate natural resources with the use and enjoyment of foods and medicines, caring for the land, passing on cultural knowledge and strengthening social bonds. Aboriginal heritage and nature are inseparable from each other and need to be managed in an integrated manner across the landscape.

The NPWS recognises that the Aboriginal people are the original custodians of the land, water and plants of the reserve. The local Aboriginal community maintains a unique and deeply felt association with and connection to the area including the reserve.

The reserve is in Bundjalung country which contains a number of tribes and clans. The reserve lies in the area traditionally occupied the Minjungbal people (Tindale 1940 cited in Navin 1990). The local Aboriginal community is officially represented by the Tweed Byron Local Aboriginal Land Council (TBLALC) and the Bundjalung Council of Elders.

The reserve has not been formally surveyed for Aboriginal cultural heritage values and there are no formal NPWS records of sites. However, the reserve as a natural landscape is important to the local Aboriginal community and also contains discrete sites of particular importance. The reserve also provides a link between significant sites in adjoining areas. NPWS will consult the Aboriginal community for the appropriate recording and management of the cultural values of the reserve.

3.5 Non-Aboriginal Heritage

European explorers arrived in the Tweed-Byron area in the early 1820s. The first Europeans to set up a permanent camp on the Brunswick River were cedar getters Steve King with John and

Edward Boyd in 1849. Large amounts of red cedar *(Toona ciliata)* were felled in the 1860s and by 1871 there were over fifty cedar getters employed on the Brunswick. Other timbers sought after were hoop pine, beech and rosewood. Red cedar was lucrative and by the turn of the 20th century most of the accessible stands were gone (Mills 2000).

Marshalls Creek was named after Bob Marshall who arrived in the early 1860s to exploit the red cedar and reportedly stock piled up to two million super feet of cedar logs. Marshall also built the first Brunswick Hotel near the ferry crossing to accommodate people waiting to cross the river. Brunswick Heads developed into a busy port for the exportation of timber. Marshalls Creek was one of the waterways used to float red cedar logs down stream into the Brunswick River for loading onto sailing ships (Mills 2000). Past logging and clearing activities in the reserve are evident in stumps of sawn mature growth trees.

In 1881 the first land selectors arrived in the Brunswick Valley to pursue dairy farming (Mills 2000). Large scale land clearing followed, particularly along the ridgelines and well-drained lowlands. During the 1880s prospecting for gold in the black sands occurred in many locations along the north coast, including the Brunswick Heads area. Around this time the first beach-front subdivision of New Brighton was created (EcoCo-ord 1998).

From the early to mid 1900s a cattle tick fence ran from the Black Scrub in Upper Main Arm past a tick gate at Billinudgel and continued along Old New Brighton Road (Frank Mills, pers comm 2008). The demolished "Janus" dip site is on Department of Primary Industries (DPI) land adjacent to the reserve on Old New Brighton Road (refer to Figure 1: Map of Marshalls Creek Nature Reserve).

In the early 1900s the Flowers family ran a large dairy farm in the area. Some of this land is now part of the reserve adjacent to Old New Brighton Road (Frank Mills, pers comm 2008). From the 1950s to the 1960s arrowroot was grown between Old New Brighton Road and Marshalls Creek (Ian Fox, pers comm 2008). Other pursuits including fishing and oyster farming have occurred within the reserve. Adjacent areas were sand mined for various minerals from 1934 to the 1960s (Frank Mills, pers comm 2008).

Most of the reserve was found to be unsuitable for permanent settlement or agriculture due to its propensity to flood. Canals and levees were constructed as early as the 1920s in many locations on the Billinudgel floodplain to aid drainage of marginal wetlands and allow for the creation of grazing land. By the late 1950s farming was largely abandoned on the coastal plain (NPWS 2000).

In the late 1950s New Brighton grew to encompass further development southward and the subdivision of South Golden Beach was established to the north (EcoCo-ord 1998). More extensive canals were constructed in the 1960s to aid the development of the area for residential use (Navin 1990). From the late 1960s to the 1980s Ocean Shores and North Ocean Shores were developed as large medium-density residential areas.

A formal systematic survey of historic sites has not been conducted in the reserve. There are no formal records of historic artefacts in the reserve and based on the available evidence it is unlikely that they occur.

3.6 Recreation and Education Values

Recreational use of the reserve is relatively low and no visitor facilities are currently provided. Visitor facilities are provided in the adjoining Brunswick Heads Nature Reserve. Most use of the reserve is by local residents. Due to the tidal nature of the reserve, the adjacent golf course and other developments vehicular access is limited. Access is possible via Old New Brighton Road, River Street and Redgate Road in the north and Rajah Road in the south.

Most of the reserve is not suitable for cycling and there are no roads or trails on the reserve. However, cycling is possible on council roads and pathways adjacent to the reserve. Byron Shire Council manages Old New Brighton Road, which traverses the reserve, and in 2007 installed a locked gate 300 metres west of Kolora Way to exclude public vehicles (refer to 5.1 Illegal Activities). Council allows the 900 metres of road west of the gate to be used as a shared bicycle and pedestrian path (refer to Figure 1: Map of Marshalls Creek Nature Reserve).

Together NPWS and MPA have conducted *Discovery* activities in the reserve and in the past these have included Aboriginal cultural awareness, bird watching, nature study and canoeing. One of the best ways to appreciate the reserve is by canoe. There are several informal access sites along Marshalls Creek where canoes may be launched. In the adjoining Brunswick Heads Nature Reserve canoes can be launched into Marshalls Creek from the end of Oyster Lease Road and the western side of the North Head Road carpark. Casons Lane near the New Brighton Post Office also provides good access to Marshalls Creek for swimming and canoe launching. Casons Lane is managed by Byron Shire Council.

Most of Marshalls Creek adjacent to the reserve is in the Marshalls Creek Sanctuary Zone of the Cape Byron Marine Park (refer to Figure 1: Map of Marshalls Creek Nature Reserve). All recreational and commercial fishing is prohibited in sanctuary zones. The area from the end of Casons Lane to a point marked approximately 500 metres south, which includes the Byron Shire Council picnic area on Marshalls Creek across the road from the New Brighton Post Office, is a Habitat Protection Zone where recreational line fishing, some netting and bait collection are permitted. Estuary mesh netting, crab and eel trapping, spear fishing and motorised personal watercraft are prohibited in all of Marshalls Creek. Some types of recreational fishing are also permitted nearby in the Habitat Protection Zones in the Capricornia Canal and the Brunswick River. All Marine Park zone boundaries are sign posted. NPWS will investigate whether any locations within the reserve are suitable for interpretive signage and may consider joint signage with MPA.

4. OTHER USES

4.1 Oyster Leases, Bait Collection and Commercial Fishing

The waters and tidal areas of Marshalls Creek in the vicinity of the reserve are within the Cape Byron Marine Park (refer to Figure 1: Map of Marshalls Creek Nature Reserve). Zoning for the Marine Park prohibits aquaculture (including oyster farming), commercial mesh netting, eel and crab trapping and bait collecting in Marshalls Creek adjacent to the reserve.

There are no oyster leases operating within the reserve or in the waters adjacent to the reserve. Oyster farming is not an appropriate activity within Marshalls Creek Nature Reserve and new leases will not be permitted in the reserve. Management of oyster leases is primarily the responsibility of the NSW Department of Primary Industries (Fisheries). The Oyster Industry Sustainable Aquaculture Strategy (Department of Primary Industries 2006) does not identify any priority oyster aquaculture areas within Marshalls Creek immediately adjacent to the reserve.

4.2 Powerlines

A Country Energy powerline, which predates gazettal of the reserve, runs through the northern part of the reserve parallel to Old New Brighton Road (refer to Figure 1: Map of Marshalls Creek Nature Reserve). The 11KV transmission line requires vegetation management within a

20 metre wide strip. Country Energy is currently working on a state-wide Memorandum of Understanding (MoU) with land managers for line maintenance. NPWS will liaise with Country Energy about the feasibility of diverting or burying the powerlines in the reserve. If this is not achievable NPWS will seek to formalise an easement with Country Energy for the existing powerline.

4.3 Redundant Sand Fly Control Infrastructure

The remains of old drain pipes, plastic sheeting and fibro cement associated with previous research into sand fly control are located in the intertidal zone of Marshalls Creek parallel to North Head Road. An assessment is required to determine if there are any environmental or public health risks associated with the remains and to determine appropriate actions.

4.4 Byron Shire Council Water Main

Byron Shire Council maintains an underground water main between Marshalls Creek and the Ocean Shores Country Club near Balemo Drive. Before conducting maintenance on the water main where it traverses the reserve Council routinely advises the NPWS and MPA. A formal agreement with Council is required to formalise access and maintenance arrangements relevant to the water main where it traverses the reserve.

4.5 Byron Shire Council Storm Water Discharge Points

During the development of Ocean Shores numerous small discharge points were constructed to allow storm water run-off from all urban areas into what was then Crown land. These discharge points are now in the reserve. Their construction predates the reserve's gazettal and a formal agreement with Council is required for access and maintenance arrangements for the discharge points on the reserve.

5. THREATS TO RESERVE VALUES

5.1 Illegal Activities

Recreational activities not consistent with the study of nature and the natural environment are generally considered inappropriate uses of a nature reserve. Although prohibited, activities such as dog walking, trail-bike riding, four-wheel driving, lighting of fires and camping occur on occasions. Several unauthorised accesses have also been established through the reserve including walking tracks, BMX bike tracks, roads, boardwalks, boat ramps, pontoons and jetties.

Due to its proximity to a large suburban area, a number of inappropriate activities currently occur in the reserve. These include ongoing incidents of illegal clearing of native vegetation; encroachment of private property use into the reserve (eg mowing and erection of garden sheds and cubby houses); planting of exotic species; and dumping of garden waste, car bodies and household rubbish. Since the reserve's gazettal NPWS has installed identification signs in prominent positions throughout the reserve in an effort to discourage these unauthorised activities.

Byron Shire Council manages Old New Brighton Road which was being used to dump stolen cars, household rubbish and weeds in the reserve. In 2007 Council closed and gated Old New Brighton Road to public vehicle access. Council, NPWS and emergency vehicles retain

vehicular access to all of Old New Brighton Road for safety and management reasons. Although the problem is greatly reduced, dumping continues along the portion of the road that cannot be closed to vehicles due to access requirements for residents.

5.2 Isolation and Fragmentation

While the reserve benefits from its proximity to Billinudgel and Brunswick Heads Nature Reserves, the clearing of vegetation in nearby urban areas impacts on biodiversity and results in fragmentation of habitat. Artificial barriers such as roads are major sources of habitat fragmentation. Roads and unauthorised trails provide access for pest animals such as cane toads, dogs, cats and foxes into the core of the reserve. The large boundary to area ratio results in detrimental edge effects such as increased vulnerability to weed invasion.

Long term conservation of biodiversity depends upon the protection, enhancement and connection of remaining habitat across the landscape, incorporating vegetation remnants on both public and private lands. Nearby vegetated areas contribute to the habitat values of the reserve and provide ecological corridors to other forested areas. Maintaining the integrity of the remaining habitat within the reserve, and where possible linking this to adjacent areas of bushland to facilitate wildlife corridors, is important in ensuring long term viability of the reserve's biological values.

5.3 Introduced Plants and Animals

Weeds are a serious threat to all of the reserve's values. Weed species occur along the reserve's boundary and in areas of previous disturbance. Dumping of garden refuse and escape of ornamental garden species into the reserve is a continuing problem. The reserve is also subject to ongoing reinfestation of weed species through the dispersal of weed propagules by tides and flood events. However, low lying areas that support mangrove and saltmarsh communities in the reserve are mostly devoid of introduced plants, with the exception of small patches of ground asparagus (*Asparagus aethiopicus*).

Noxious weeds known to occur in the reserve are lantana (*Lantana camara*), camphor laurel *(Cinnamomum camphora)*, mistflower (*Ageratina riparia*), crofton weed *(Ageratina adenophora),* bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*), groundsel bush (*Baccharis halimifolia*), and madeira vine *(Anredera cordifolia)*. Environmental weeds in the reserve include winter senna (*Senna pendula* var. *glabrata*)*,* pigeon grass (*Setaria spp*), small-leaved privet (*Ligustrum sinense*), large-leaved privet (*Ligustrum lucidum*), asparagus fern (*Asparagus africanus*), climbing asparagus *(A. plumosus),* ground asparagus *(A. aethiopicus),* coastal morning glory (*Ipomoea cairica*), glory lily (*Gloriosa superba*), coral berry (*Ardisia crenata*), Singapore daisy (*Wedelia trilobata*) and aerial yam (*Dioscorea bulbifera*).

Introduced animals present in Marshalls Creek Nature Reserve include the European red fox (*Vulpes vulpes*), feral cat (*Felis catus*), and cane toad (*Bufo marinus*). Because of the large urban interface there is a significant threat to the reserve's native wildlife from straying domestic cats and dogs (*Canis lupus familiaris*). Illegal dog walking is also a problem in the reserve (refer to 6.1 Illegal Activities). Introduced animals impact upon native fauna either directly through predation, or indirectly through competition for food and shelter or by disturbance caused by their presence or scent.

A weed management plan for the RTA Pacific Highway upgrade compensatory habitat additions has been prepared (Bushland Restoration Services, 2009). A Pest Management Plan for the whole reserve is being prepared in accordance with the Northern Rivers Region Pest Management Strategy (DECC 2007).

5.4 Water Quality, Acid Sulphate Soils and Changes to Hydrology

Marshalls Creek is subject to runoff from the adjacent urban landscape, including sediment and pollutants from stormwater discharge. Run-off from residential areas has the potential to introduce pollutants such as soil, fertilisers, pesticides, pathogens, grass, plastics, litter, oil, grease and metal particles, as well as a range of other compounds and weed propagules.

Extensive drainage canals and levees near the reserve have been developed for the drainage of wetland areas and to improve the viability of the land for grazing, cane farming and residential land uses. Some of these canals and levees date back to the 1920s and 1930s. The drainage works have had a major impact on the hydrology of the floodplain, through altered groundwater levels and the release of acid sulphate soils (ASS), though much of this impact is probably confined to areas to the north of the reserve and the adjoining Billinudgel Nature Reserve (Navin 1990; NPWS 2000). Low estuarine flushing in the Capricornia Canal has resulted in poor water quality, low levels of dissolved oxygen and ASS, causing occasional fish kills including whiting, sole, herrings, eels and juvenile prawns (Parker 2001). In April 2007 Byron Shire Council approved plans to enlarge the pipes in the Kallaroo Circuit bund. The effects of these works on the hydrology of Marshalls Creek are undetermined.

Changing catchment conditions such as deforestation, farming and urban development have probably increased runoff and suspended sediment loads. Human action and natural events have changed channel conditions. The addition of training walls at the entrance of Marshalls Creek has increased sand accretion in the lower estuary since the late 1960s (Warner 1988).

Mangroves and seagrass *(Zostera capricorni)* along the mid to lower reaches of Marshalls Creek are under threat due to pollution, sedimentation and waterway use (Patterson, Britton and Partners 2005). Access to Marshalls Creek for boating, swimming and other activities has caused erosion of some sections of the bed and banks of the creek. This in turn may impact on habitat for juvenile fish and crustaceans including species important to fisheries such as snapper (*Crysophrys auratus*), mangrove jack (*Lutjanus argentimaculatus*), and blue spotted flathead (*Platycephalus caeruleopunctatus*) (Marine Parks Authority 2003).

The Byron Shire Council's Brunswick Estuary Management Committee has supervised the preparation of the Brunswick Estuary Management Plan, which includes Marshalls Creek. The primary objective of the plan is to develop a range of management strategies for maintaining and improving estuary condition and function. One of the key management strategies is revegetating and maintaining adequate riparian buffer strips on all waterways (Patterson, Britton and Parnters 2006).

5.5 Climate Change/Sea-Level Rise

Sea-level rise is one of the projected outcomes of climate change documented over the last decade by the Inter-governmental Panel on Climate Change (IPCC). The IPCC predicts a rise in sea levels of between 18 centimetres and 59 centimetres by 2100 (IPCC 2007). The rate and magnitude of sea-level change is likely to vary from region to region and to date there is little agreement as to the pattern of sea-level rise. Changes in sea level will be felt through: increases and intensity and frequency of storm surges; increased erosion; loss of important wetlands and mangroves; impact on coastal ecosystems and impact on human settlements (CSIRO 2005).

On the Australian coast, impacts of sea-level rise and storm surges could be expected along the full length of the tropical coast. On the NSW coast, where narrow continental shelf limits the size of storm surges, large wind driven waves can have significant impacts (CSIRO 2005).

Climate change may significantly affect biodiversity by changing population size and distribution of species, modifying species composition, and altering the geographical extent of habitats and ecosystems. The potential impact of climate change is difficult to assess since it depends on the compounding effects of other pressures, particularly barriers to migration. Species most at risk are those unable to migrate or adapt, particularly those with small population sizes or with slow growth rates (Department of Environment and Conservation 2006). For the reserve the most direct impact would be on the extent of the coastal wetlands, which are already under threat from a range of pressures.

Anthropogenic Climate Change has been listed as a key threatening process under the TSC Act. Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases is listed as a key threatening process under the EPBC Act.

There is evidence suggesting that the rate of climate change will be faster than the rate at which many species can adapt, either by migration or by changing their behaviour, physiology or form. Hence, one short-term goal for management is to ensure the survival of species in spite of additional threats from climate change. Some existing programs designed to manage threatening processes may also enhance species adaptability or resilience to impacts from climate change, examples include management programs for pest animals and weeds (Department of Environment and Heritage 2007). Increasing habitat connectivity and appropriate fire management may also improve the ecological resilience of species.

5.6 Fire

Fire is a natural feature of many environments and is essential to the survival of some plant communities. However, inappropriate fire regimes, related to fire frequency, season, and intensity can lead to loss of particular plant and animal species and communities. The ecological consequences of high frequency fire have been listed as a key threatening process under the TSC Act.

The primary fire management objectives of the NPWS are to protect life, property and community assets from the adverse impacts of fire, whilst managing the fire regimes to maintain and protect biodiversity and cultural heritage (Department of Environment and Conservation 2006).

The NPWS Fire Management Manual (Department of Environment and Conservation 2006) uses a zoning system for bushfire management in NPWS reserves that is compatible with that developed by the Bush Fire Coordinating Committee for use in District Bush Fire Management Committee (DBFMC) bushfire risk management plans. Annual hazard reduction programs, which may include mechanical fuel reduction techniques, prescribed burning and fire trail works, are submitted to the DBFMC.

In accordance with sections 38(4) and 44(3) of the *Rural Fires Act* 1997, a NPWS Regional Fire Management Strategy has been prepared for the reserve (Department of Environment and Conservation 2005).

Most of the reserve is wetland, mangroves or other moist coastal vegetation types on floodplain. Wildfires have not been recorded within the reserve since 2002. The reserve does not have a history of frequent bushfire ignitions or known areas of high bushfire behaviour potential. There are a number of assets that border the reserve, including a large residential interface and the Ocean Village Shopping Centre and Ocean Shores Tavern. The area adjacent to the Ocean Village Shopping Centre and Tavern is currently cleared and maintained as an Asset Protection Zone (APZ). There are no built assets that are vulnerable to fire in the reserve.

NPWS maintains cooperative arrangements with surrounding landowners and Rural Fire Service brigades and is actively involved in the Far North Coast Bush Fire Management Committee. Cooperative arrangements include approaches to fuel management, support for neighbours' fire management efforts and information sharing.

6. MANAGEMENT ISSUES AND STRATEGIES

Current Situation	Desired Outcomes	Management Strategies	Priority
6.1 Soil and water conservation The reserve is subject to varying degrees of tidal influence, flooding and natural coastal erosion processes. Erosion in the reserve is exacerbated by unauthorised access along sections of the creek banks. Water quality is affected by stormwater and sewage discharge from the surrounding urban catchment. Extensive drainage canals and levees in the surrounding area have changed groundwater levels, reduced flushing of the Capricorn Canal and released Acid Sulphate Soils (ASS). Occasional fish kills have occurred in Marshalls Creek. The pipes in the Kallaroo Circuit bund are proposed to be enlarged with unknown effects on Marshalls Creek. NPWS is represented on the Byron Shire Council's Estuary Management Committee overseeing the implementation of the Brunswick Estuary Management Plan. This plan aims to maintain and improve estuary condition and function.	• Natural hydrological and erosion processes continue with minimal disturbance. • Erosion from human induced use is minimised. • Water quality and health of Marshalls Creek is improved.	6.1.2 Continue NPWS participation on the Byron Shire Council's Estuary Management Committee.	LOW

6.2 Native plant and animal conservation Although only limited surveys have been conducted in the reserve it is known to support six Endangered Ecological Communities (EECs), 12 flora and 22 fauna species listed as endangered or vulnerable under the *Threatened Species Conservation Act* 1995. Threatened Species Recovery Plans have been prepared for the Crystal Creek walnut, bush-stone curlew and little tern. Recovery actions are included in the Priorities Action Statement for the Crystal Creek walnut, Davidson's plum, Durobby and several native fauna species (refer to 3.3 Native Fauna). The reserve also supports important remnant vegetation of state significance including wetlands (SEPP 14) and littoral rainforest (SEPP 26). Based on records for nearby areas it is likely that many other significant flora and fauna occur in the reserve. The reserve is an important foraging and roosting habitat for many species of migratory and resident shorebirds protected under international agreements. Major impacts on native flora and fauna include introduced species and visitor use. Surrounding development fragments the reserve and increases the reserve's exposure to invasion by introduced species and presents a barrier to wildlife	• All native plant and animal species and communities are conserved. • Knowledge of the reserve's plants and animals and their ecological requirements is improved.	6.2.1 Implement relevant strategies in the Priorities Action Statement and recovery plans for threatened species. 6.2.2 Encourage research and monitoring on native species, in particular threatened species, consistent with strategies identified in the PAS and recovery plans (refer to 6.8 Research and monitoring).	MEDIUM LOW

movement. Native regeneration is occurring in some areas disturbed by past land use but this natural process is currently being compromised by weed infestation (refer to 6.4 Introduced Species). Volunteer groups are assisting by undertaking bush regeneration works in the reserve. Climate change is also recognised as a key threatening process. Appropriate fire and pest management may improve the ecological resilience of species (refer to 6.4 Introduced Species and 6.5 Fire Management).			
6.3 Cultural heritage The reserve is within the Tweed Byron Local Aboriginal Land Council. It is within the traditional lands of the Bundjalung and is part of the landscape of cultural importance to the local Bundjalung people. NPWS does not have formal records of any historic or Aboriginal heritage sites in the reserve, however no formal systematic surveys have been undertaken. Any research into the reserve's Aboriginal cultural heritage values should be undertaken in consultation with the Tweed Byron LALC and Bundjalung Council of Elders and other relevant Aboriginal community organisations.	Aboriginal and historic features and values are identified and protected. Aboriginal people are involved in management of the Aboriginal cultural values in the reserve. Understanding of the cultural significance of the reserve is improved.	6.3.1 Continue consultation and involvement of the Tweed-Byron Local Aboriginal Land Council, the Bundjalung Council of Elders and other relevant Aboriginal community organisations in the management of Aboriginal sites, places and values, including interpretation of places or values.	MEDIUM

6.4 Introduced species Weeds are concentrated along the reserve boundary and in disturbed areas such as the recent additions in the north of the reserve. Dumping of garden rubbish and garden "escapees" is a continuing problem. Tidal and flood events also cause reinfestation of weed species. Noxious weeds in the reserve include camphor laurel, bitou bush, lantana, madeira vine, mistflower, groundsel bush and crofton weed. Environmental weed species include ground asparagus, glory lily, pigeon grass, privet and winter senna. Dogs, cane toads, foxes and feral cats occur in the reserve. The pandanus planthopper is a potential threat to pandanus trees in the reserve. The Pandanus Plant Hopper Management Strategy for North East NSW provides for ongoing biannual monitoring of pandanus trees in the reserve.	• High priority introduced species are controlled, and their impacts on the reserve's values are minimised.	6.4.1 Manage pest species in accordance with the Northern Rivers Region Pest Management Strategy. 6.4.2 Prepare and implement a Pest Management Plan for the reserve.	HIGH HIGH

6.5 Fire management A Fire Management Strategy has been prepared for the reserve (2005). The last wildfire recorded in the reserve was in 2002. The reserve is dominated by wetland, mangrove and other moist vegetation communities and there is no history of frequent bushfire ignitions. There are a number of assets that border the reserve, including a large residential interface and the Ocean Village Shopping Centre and tavern. There are no built assets that are vulnerable to fire in the reserve.	Life and property are protected from fire. Fire is managed cooperatively. Fire frequencies are appropriate for conservation of native plant and animal communities as specified in the FMS.	6.5.1 Implement the Fire Management Strategy for the reserve and update as required.	HIGH

6.6 Public use The reserve experiences low levels of recreational use. There are no recreational facilities within the reserve. Activities include bird watching, canoeing and nature study. NPWS and MPA *Discovery* activities promote the values of the reserve. Inappropriate recreational uses of the reserve include camping, lighting of fires, four-wheel driving, trail-bike riding, and dog walking. Several unauthorised walking tracks, roads, boardwalks, boat ramps, jetties and pontoons have been constructed by park visitors and neighbours. Promotion of community understanding and appreciation of the reserves values will be important for minimising damaging activities and encouraging nature based use of the reserve. The MPA and DPI regulate fishing in Marshalls Creek. Recreational fishing is prohibited in the Marshalls Creek Sanctuary Zone in the Cape Byron Marine Park. Some types of recreational fishing are permitted in the Habitat Protection Zone in the vicinity of the New Brighton Post Office. Motorised personal watercraft, such as jetskis, are prohibited in all zones of the Marine Park. Encroachment of private property use into the reserve occurs adjacent to some residential areas. Illegal clearing, dumping of garden refuse, car bodies and rubbish also occurs.	• Visitor use is low key, self reliant and compatible with the values of the reserve and compliments other surrounding recreational opportunities. • The local community is aware of the significance of the area and of NPWS management programs. • Unauthorised activities and structures are excluded from the reserve.	6.6.1 Allow low impact self reliant nature based use of the reserve such as canoeing, bird watching and nature study. 6.6.2 Cycling is not provided for in the reserve, but is permissible on Council managed roads traversing the reserve such as part of Old New Brighton Road. 6.6.3 Prohibit camping, camp fires and public vehicle use. 6.6.4 Permit group educational activities that are consistent with the values of the reserve subject to NPWS consent. For this reserve a group is defined as ten or more people. 6.6.5 NPWS and MPA *Discovery* programs in the reserve may continue to be promoted subject to demand and NPWS regional priorities. 6.6.6 Install reserve identification and regulatory signs at major reserve entrances and focal points. Liaise with Marine Parks Authority and Byron Shire Council about a cooperative approach to regulatory signage and appropriate interpretative information. 6.6.7 Remove and/or close any unauthorised structures (including boat ramps, boardwalks, pontoons, jetties) and walking tracks and undertake law enforcement as necessary. Liaise with Industry and Investment NSW regarding any permit requirements where removal of any unauthorised structures may impact on marine vegetation.	HIGH HIGH HIGH HIGH MEDIUM HIGH HIGH

6.7 Other uses Old drain pipes, plastic sheeting and fibro cement associated with previous research into sand fly control are located in the intertidal zone of Marshalls Creek parallel to North Head Road. Currently there are no oyster leases operating within or adjacent to the reserve. Oyster farming is not consistent with management of a nature reserve or with the zoning of the adjoining section of the Cape Byron Marine Park. An 11kv Country Energy powerline runs through the northern part of the reserve parallel to Old New Brighton Road. The powerline predates gazettal of the reserve. Vegetation management is required within a 20m wide strip of the line. Country Energy is working on a state-wide MoU with land managers affected by powerlines. Byron Shire Council maintains an underground water main between Marshalls Creek and the Ocean Shores Country Club near Balemo Drive. Council also maintains numerous storm water discharge points on the reserve adjacent to urban areas.	All essential non-NPWS facilities are licensed. Existing non-NPWS infrastructure is managed to minimise impacts on natural and cultural values. No new non-NPWS infrastructure is developed in the reserve.	6.7.1 Undertake an assessment of any environmental or public health risks that may be associated with the former sand fly control site near North Head Road and determine appropriate action. This may include removal of the infrastructure. 6.7.2 Prohibit oyster leases in the reserve consistent with NPWS policy. 6.7.3 Liaise with Country Energy about the feasibility of removing the powerline or moving it underground where it traverses the reserve. If this is not achievable seek to formalise an easement with Country Energy for the existing powerline. 6.7.4 Liaise with Byron Shire Council to formalise their access and maintenance arrangements to the water main and storm water discharge points where they traverse the reserve.	LOW HIGH LOW LOW

High priority activities are those imperative to achievement of the objectives and desired outcomes. They must be undertaken in the near future to avoid significant deterioration in natural, cultural or management resources.

Medium priority activities are those that are necessary to achieve the objectives and desired outcomes but are not urgent.

Low priority activities are desirable to achieve management objectives and desired outcomes but can wait until resources become available.

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