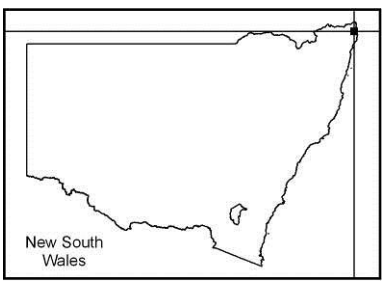
NSW National Parks & Wildlife Service
Office of Environment & Heritage

Plan of Management

Jinangong Nature Reserve



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This plan of management was adopted by the Minister for the Environment on 20 October 2016.

Acknowledgments

This plan of management was prepared by staff of the NSW National Parks and Wildlife Service (NPWS), Northern Rivers Region, part of OEH.

NPWS acknowledges that Jinangong Nature Reserve is in the traditional Country of the Bundjalung People.

For additional information or any inquiries about this reserve or its plan of management, contact the NPWS Tweed-Kyogle Area, PO Box 724 Murwillumbah NSW 2484, or by telephone on 02 6670 8600.

Front cover images: *Left*: Crystal Creek walnut (*Endiandra floydii*). Photo: TM Tame/The Royal Botanic Gardens and Domain Trust. *Right*: Bangalow palms along the reserve creek. Photo: N McCubbin©.

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Foreword

Jinangong Nature Reserve is situated near Brunswick Heads on the NSW Far North Coast. It was reserved in 2010.

The reserve was previously private land which was purchased as compensatory habitat to offset some of the environmental impacts of the Pacific Highway upgrade. It protects a significant stand of lowland rainforest, a community which is considered critically endangered at a national level, including what is believed to be the largest remnant of floodplain rainforest in the Brunswick Valley.

The reserve has been used as a translocation site for many threatened plant species displaced by the Pacific Highway upgrade. It is also being used as a translocation site for the hairy quandang, as part of the conservation plan to recover that endangered species.

The NSW *National Parks and Wildlife Act 1974* requires that a plan of management be prepared for each nature reserve. A draft plan of management for Jinangong Nature Reserve was exhibited between 16 September and 16 December 2013. The two submissions received on the draft plan were carefully considered before adopting this plan.

This plan contains a number of actions to improve protection of our natural environment, including protection of threatened species and communities, bush regeneration and control of pest plants.

Being a nature reserve, provision for visitor use is not a priority for management. As the reserve has no legal public vehicular access, opportunities for visitor use are highly constrained. However, the plan promotes engagement with the community through volunteer bush regeneration programs and the hosting of field days to promote the values of the reserve. Low key, nature-based activities such as bird watching and bushwalking are also permitted.

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

Mark Speakman
Minister for the Environment

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1. Introduction

1.1 Location, reservation and regional setting

Features	Description
Location	Jinangong Nature Reserve (referred to as 'the reserve' in this plan) is located approximately 4 kilometres north-west of Brunswick Heads in far north-east New South Wales. The village of Billinudgel lies to the north with Ocean Shores (population 10,000) to the east (see Figures 1 and 2).
Area	The reserve has a total area of 49.26 hectares comprising two sections separated by an unformed road easement. The northern section of the reserve is approximately 16.9 hectares and the southern section is approximately 32.4 hectares.
Reservation date	Jinangong Nature Reserve was reserved on 22 October 2010. The name of the reserve 'Jinangong' was selected after consultation with the Tweed-Byron Local Aboriginal Land Council.
Previous tenure	Before its reservation, the area was freehold land. It was purchased by the then NSW Roads and Traffic Authority in 2000 for dedication to the NSW reserve system as part of a compensatory habitat package for impacts associated with the Brunswick to Yelgun Pacific Highway upgrade.
Regional context	
Biogeographic region	The reserve is within the Burringbar-Conondale Ranges Subregion that forms a part of the South Eastern Queensland Bioregion. The reserve is part of a system of protected areas in north-east New South Wales including Billinudgel, Brunswick Heads and Inner Pocket nature reserves, all of which are within 10 kilometres of the reserve. Also nearby are the Tweed Caldera rainforest parks and reserves.
Surrounding land use	Land to the west of the reserve is used for rural purposes such as cattle grazing. Several rural residential properties adjoin the reserve on the northern boundary and a number are in proximity to the eastern boundary, separated only by the railway line. A small, seldom-used quarry is located near the north-west boundary of the reserve. The Casino–Murwillumbah railway line runs parallel to the eastern boundary of the reserve at an offset distance of about 25 metres. This section of the railway was operational from 1894 to 2004. NorthPower installed a high voltage cable enclosed by a galvanised metal trough along the western boundary of the railway easement in 2000. The Pacific Highway is to the east of the railway line.
Other authorities	The reserve is located within the areas of the Tweed Byron Local Aboriginal Land Council, North Coast Local Land Services and Byron Shire Council.

1.2 Statement of significance

Jinangong Nature Reserve is significant because of the following values:

Biological values

- Two endangered ecological communities and 18 threatened plant species, including 10 species that are recognised as nationally threatened, are found within the reserve. A further 4 species in the reserve are considered significant due to their rarity. The lowland rainforest endangered ecological communities present in the reserve are considered critically endangered at the national level.
- The reserve provides habitat for four threatened animal species, two of which are also recognised as threatened at a national level, and is likely to provide habitat for a further three threatened species.
- The reserve is part of a network of parks and reserves in the area that provides important wildlife corridors linking hinterland and coastal habitats.

Aboriginal heritage

- The reserve is located in the traditional lands of the Bundjalung People.
- The reserve is viewed as a part of a larger cultural landscape that includes resources, stories, spirituality and lore that is significantly important to the Bundjalung Peoples' identity and way of life.

Research and education opportunities

- Significant vegetation communities and animal populations in the reserve provide opportunities for scientific research and education.
- The reserve provides an opportunity to monitor long-term native plant and animal rehabilitation and the success of bush regeneration techniques.

Community values

- The local community, in particular neighbours and Brunswick Valley Landcare, has had a long association with the reserve that pre-dates its reservation. This group continues to meet once a month for bush regeneration activities within the reserve.

2. Management context

2.1 Legislative and policy framework

The management of nature reserves in New South Wales is in the context of the legislative and policy framework of the NSW National Parks and Wildlife Service (NPWS), primarily the *National Parks and Wildlife Act 1974* and National Parks and Wildlife Regulation, the *Threatened Species Conservation Act 1995* and NPWS policies.

Other legislation, strategies and international agreements may also apply to management of the area. In particular, the NSW *Environmental Planning and Assessment Act 1979* may require assessment of environmental impact of works proposed in this plan. The NSW *Heritage Act 1977* may apply to the excavation of known archaeological sites or sites with potential to contain historical archaeological relics. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* may apply in relation to actions that impact matters of

national environmental significance, such as migratory and threatened species listed under that Act.

A plan of management is a statutory document under the National Parks and Wildlife Act. Once the Minister has adopted a plan, the plan must be carried out and no operations may be undertaken in relation to the lands to which the plan relates unless the operations are in accordance with the plan. This plan will also apply to any future additions to Jinangong Nature Reserve. Should management strategies or works be proposed in future that are not consistent with this plan, an amendment to the plan will be required.

2.2 Management purposes and principles

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

Under the National Parks and Wildlife 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
- provide for appropriate research and monitoring.

The primary purpose of nature reserves is to conserve nature. Nature reserves differ from national parks in that they do not have the provision of visitor use as a management purpose or principle.

2.3 Specific management directions

In addition to the general principles for the management of nature reserves (see Section 2.2) the following specific management directions apply to the management of the reserve:

- protect the reserve's threatened species and endangered ecological communities
- restore native plant and animal communities
- control introduced plant and animal species
- protect the reserve's cultural significance
- allow low-impact recreational use such as bushwalking and birdwatching
- encourage community involvement in the restoration of the reserve's native vegetation.

3. Values

This plan aims to conserve the natural and cultural values of the reserve. The location, landforms and plant and animal communities of an area have determined how it has been used and valued by Aboriginal and non-Aboriginal people. 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. To make the document clear and easy to use, various aspects of natural heritage, cultural heritage, threats and ongoing use are dealt with individually but their interrelationships are recognised.

3.1 Geology, landscape and hydrology

The reserve is composed primarily of rocks of the Neranleigh–Fernvale beds, which are the major constituent of the Beenleigh Block (Brown et al. 2003). These are the oldest rocks in the region (Carboniferous age), and include metamorphosed sandstones (arenites), metamorphosed siltstones, mudstone and shale (Brown et al. 2014). A small area of Quaternary-aged alluvium occurs in the north-east of the reserve. Basalt has not been identified within the reserve, although it is depicted on current geological maps and soil landscape maps as an outcrop capping the main ridge line.

The main ridge line that runs diagonally north-east to south-west features two saddles with a maximum elevation of 110 metres in the south-west. The ridge side slopes have an easterly aspect with a gradient of approximately 20%.

The Burringbar soil landscape, rolling hills on the Neranleigh–Fernvale beds (Morand 1994), occupies the majority of the reserve. Soils are generally Red/Brown Kurosols (soils with strong texture contrast between topsoil and strongly acidic subsoil) and Red/Brown Dermosols (well-structured soils with minor texture change). Soils associated with the Burringbar soil landscape generally have low to moderate fertility and are susceptible to mass movement hazard, including batter collapse (Morand 1994).

The Quaternary alluvium in the north-east of the reserve consists of two distinct surfaces: a floodplain that experiences regular flooding; and an alluvial plain that is less regularly inundated. The floodplain consists of fresh deposits of gravelly sediment interspersed with clayey sediments and some rudimentary soils (Rudosols). Sediment material is derived predominantly from the metamorphic hills. The alluvial plain occurs as an elevated surface above the floodplain; the soils are generally Brown Dermosols and Brown Kurosols. They are often very erodible, being dispersive (structurally unstable) and hard setting, often resulting in higher runoff and poor seedbed conditions.

The margins of the alluvial plain, often small (0.5–1 metre) scarps abutting the floodplain, appear to have been scoured and eroded by floodwaters, the erosion possibly increased by clearing and grazing. Relatively fertile topsoil (A1 horizon) has been stripped in places, exposing less fertile, bleached subsoil. Construction of the railway line batter has probably changed the hydrology and depositional characteristics of this surface by restricting runoff. The disturbed floodplain will be difficult to revegetate due to the infertile nature of the surface soil and its possible dispersive (when wet) and hard setting (when dry) properties.

A small, permanent watercourse meanders across the north-east of the reserve, flowing in a north-easterly direction to drain into Marshalls Creek and eventually the Brunswick River. Although officially unnamed, older long-term residents call this watercourse ‘Strike-a-light Creek’ (see Section 3.4). The previous construction of several small dams in and around what is now the reserve has affected local hydrological processes. The mean annual rainfall for the

area is approximately 1747 millimetres, most of which falls from January to May (BoM 2012). The low lying areas are subject to flooding during high rainfall events.

In accordance with standard NPWS practice, management activities (i.e. road maintenance, fire suppression, weed control etc.) in the reserve will be carried out in a manner that minimises soil erosion and water pollution.

Issue

- Past land-use practices, such as land clearing, railway construction and agricultural practices, have impacted hydrological processes and soil stability in the reserve. These pose a risk to water quality downstream of the reserve. Restoration of vegetation in disturbed areas (see Section 3.2) and control of weed species (see Section 4.1) will assist in the long-term improvement of water quality in this part of the Brunswick Catchment.

Desired outcome

- The integrity of the catchment is improved.

Management response

3.1.1 Restore vegetation communities in disturbed areas as much as possible and implement bush regeneration programs to control weed species to reduce soil erosion and runoff.

3.2 Native plants

With the exception of the rainforest remnants in the sheltered gullies and around the creek in the north-east, most of the reserve has been grazed or cleared at some stage after European settlement and before its reservation. A 1 hectare clearing dominated by pasture grasses remains in the north-east of the reserve (see Figure 2). In 2001 over 30 volunteers from nine different community groups helped plant more than 700 native trees on the edge of the clearing parallel to the railway line. The plants were supplied by NorthPower as compensation for damage to vegetation caused during the installation of a powerline adjacent to the reserve in 2000. Unfortunately, only 40% survived due to drought conditions at the time and browsing by swamp wallabies (J Taylor 2012, pers. comm., 19 June).

A number of vegetation surveys have been undertaken within the reserve including those by Fitzgerald (1995), Benwell (2002), Gunninah Environmental Consultants (1998), Andrew Benwell and Lui Weber in 2006 (Sheringham et al. 2008) and Bailey (2010). Rainforest ecologist John Hunter also surveyed the rainforest remnant in 1996 while employed by NPWS.

Four broad vegetation communities are found within the reserve:

- wet sclerophyll forest
- dry sclerophyll forest
- lowland subtropical rainforest
- disturbed regrowth.

The wet sclerophyll forest is a very tall open forest dominated by brush box (*Lophostemon confertus*) and blackbutt (*Eucalyptus pilularis*). The dry sclerophyll forest is characterised by broad-leaved white mahogany (*E. carnea*) and grey ironbark (*E. siderophloia*) tall open forest. Camphor laurel (*Cinnamomum camphora*) and sally wattle (*Acacia melanoxylon*) dominate the areas of disturbed regrowth (Bailey 2010; Benwell 2002). Most of the eucalypt forest is at a mature growth stage with a few older, hollow-bearing individual trees.

The subtropical rainforest occurs on the floodplain and slightly up slope. The former meets the specifications for Lowland Rainforest on Floodplain in the NSW North Coast Bioregion, while the latter meets the specifications for Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions, both of which are listed as endangered ecological communities (EECs) under the Threatened Species Conservation Act. In this region of New South Wales, both types of rainforest also qualify as the critically endangered ecological community Lowland Rainforest of Subtropical Australia listed under the Environment Protection and Biodiversity Conservation Act. Covering approximately 2 hectares, the lowland rainforest on floodplain in the reserve is possibly the largest example of this EEC in the Brunswick River catchment. Dominant species include black bean (*Castanospermum australe*), red bean (*Dysoxylum mollissimum* subsp. *molle*), blush coondoo (*Pouteria queenslandica*) and bangalow palm (*Archontophoenix cunninghamiana*). Blue quandong (*Elaeocarpus grandis)* is prolific along the creek adjacent to the clearing in the north-east part of the reserve.

The reserve supports 18 threatened plant species listed under the Threatened Species Conservation Act (OEH 2014). A further four species in the reserve are considered Rare or Threatened Australian Plants (ROTAP) by Briggs and Leigh (1995).

Table 1: Threatened and significant plant species recorded in the reserve

Common name	Scientific name	TSC Act status	EPBC Act status	ROTAP status
Marblewood^	*Acacia bakeri*	V	-	-
White lace flower^	*Archidendron hendersonii*	V	-	-
Veiny lace flower^	*Archidendron muellerianum*	-	-	3RCa
Stinking cryptocarya^	*Cryptocarya foetida*	V	V	3VCi
Long-leaved tuckeroo	*Cupaniopsis newmanii*	-	-	2RC-
Davidson's plum*	*Davidsonia jerseyana*	E	E	2ECi
Hairy quandong^	*Elaeocarpus williamsianus*	E	E	2ECi
Crystal Creek walnut*	*Endiandra floydii*	E	E	2VC-
Black walnut*	*Endiandra globosa*	-	-	2RC-
Green-leaved rose walnut*	*Endiandra muelleri* subsp. *bracteata*	E	-	-
White yiel yiel^	*Grevillea hilliana*	E	-	-
Fine-leaved tuckeroo	*Lepiderema pulchella*	V	-	2RC-
Rough-shelled bush nut^	*Macadamia tetraphylla*	V	V	2VC
Clear milkvine	*Marsdenia longiloba*	E	V	3RC-
Northern evodia	*Melicope vitiflora*	E	-	-
Southern ochrosia	*Ochrosia moorei*	E	E	2ECi
Spiny gardenia*	*Randia moorei*	E	E	3ECi
Smooth scrub turpentine	*Rhodamnia maideniana*	-	-	2RC-
Rainforest cassia	*Senna acclinis*	E	-	3RC-
Red lilly pilly*	*Syzygium hodgkinsoniae*	V	V	3VC
Durobby*	*Syzygium moorei*	V	V	2VCi
Queensland xylosma^	*Xylosma terrae-reginae*	E	-	-

Source: OEH (2014); E = Endangered; V = Vulnerable

* = translocated and naturally occurring in the reserve previously; ^ = translocated only

Key to ROTAP codes: (continues on next page)

2 = Geographic range in Australia less than 100km

3 = Geographic range in Australia more than 100 km
E = Endangered – at serious risk of extinction in the short term (one or two decades)
V = Vulnerable – at risk of extinction over a longer period (20–50 years)
R = Rare – with no current threat
C = Occurs within a conservation reserve
a = Species is considered to be adequately reserved – 1000 or more plants within a proclaimed reserve
i = Species is considered to be inadequately reserved – less than 1000 plants occur within a proclaimed reserve
- = Species is recorded from a reserve but the population size is unknown

In 2004, the then Roads and Traffic Authority (RTA – now part of Roads and Maritime Services) commenced a translocation project, whereby significant and threatened plant species that would have been harmed during the construction of the Brunswick Heads to Yelgun Pacific Highway upgrade were removed and planted in the cleared areas within the then proposed reserve (Benwell 2004). The two translocation sites are shown in Figure 1. Some of the translocated species also occurred naturally in the reserve before the translocation project as shown in Table 1.

In 2011, the reserve was selected as one of several translocation sites in an OEH project designed to help recover the endangered hairy quandong. This species only occurs in far north-east New South Wales, has low genetic diversity and low seed production, making it more susceptible to extinction. The intent is to bring together a selection of plants grown from cuttings from across the species' geographical and genetic distribution with the aim of maximising opportunities for cross-pollination, and thus increasing genetic diversity and thereby resilience (Brown 2011).

Several seedling and juvenile examples of the vulnerable fine-leaved tuckeroo also occur in the reserve. However, it is likely they are self-introduced from the neighbouring property where they were planted by the landholders.

Plants found in the reserve that are not listed as rare or threatened but are considered uncommon in New South Wales are the Eumundi quandong (*Elaeocarpus eumundi*), pinkheart (*Medicosma cunninghamii*), blush coondoo and thin-leaved coondoo (*Planchonella chartacea*). Pinkheart only occurs in the reserve due to the translocation program. While thin-leaved coondoo has also been used in the translocation program, it also occurred previously in the reserve.

Strategies for the recovery of threatened species, populations and ecological communities have been set out in a statewide *Threatened Species Priorities Action Statement* (DECC 2007). These actions are currently prioritised and implemented through the *Saving our Species* program, which aims to maximise the number of threatened species that can be secured in the wild in New South Wales for 100 years (OEH 2013c). Individual recovery plans may also be prepared for threatened species to consider management needs in more detail. A multispecies recovery plan has been approved that covers all of the significant species found in the reserve (DECCW 2010a).

Issue

- The most significant threats to native species and communities are inappropriate fire regimes and introduced plant species that inhibit the regeneration of native and endemic rainforest species. The reserve's relatively small size increases its vulnerability to these impacts.

Desired outcomes

- Populations of significant plant and ecological communities are conserved and negative impacts on threatened species are minimised.
- The habitat and populations of all threatened plant species are protected and maintained.

- Structural diversity and habitat values are restored in degraded areas.

Management response

3.2.1 Implement relevant strategies in the Priorities Action Statement and recovery plans for threatened plant species, populations and ecological communities present in the reserve, including appropriate pest and fire management and monitoring of the translocated hairy quandongs.

3.2.2 Restore native vegetation communities through weed control, replanting and/or promoting natural regeneration.

3.2.3 Support the involvement of volunteer groups in habitat restoration programs.

3.2.4 Monitor vegetation cover in the reserve, particularly in disturbed areas and areas subject to replanting, so the effectiveness of regeneration activities can be assessed.

3.3 Native animals

While no formal fauna surveys have been conducted within the reserve, four threatened species have been recorded from opportunistic sightings (OEH 2014). The reserve contains diverse habitats that are contiguous with adjoining lands. Threatened species recorded nearby that are likely to visit or inhabit the reserve have been included in Table 2. Other threatened species likely to occur in the reserve due to the availability of suitable habitats are the square-tailed kite (*Lophoictinia isura*), wompoo fruit-dove (*Ptilinopus magnificus*), common planigale (*Planigale maculata*) and the little bentwing-bat (*Miniopterus australis*) (DEC 2005). The rainbow bee-eater (*Merops ornatus*), which is listed as a migratory species under the Environment Protection and Biodiversity Conservation Act, has also been recorded in the reserve.

Table 2: Threatened animal species recorded in and within 1 kilometre of the reserve

Common name	Scientific name	TSC Act status	Recorded in reserve
Birds			
Glossy black-cockatoo	*Calyptorhynchus lathami*	Vulnerable	-
White-eared monarch	*Carterornis leucotis*	Vulnerable	Yes
Rose-crowned fruit-dove	*Ptilinopus regina*	Vulnerable	Yes
Mammals			
Eastern bentwing-bat	*Miniopterus schreibersii oceanensis*	Vulnerable	-
Koala *	*Phascolarctos cinereus*	Vulnerable	Yes
Grey-headed flying-fox *	*Pteropus poliocephalus*	Vulnerable	Yes

*Also listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act*

The reserve forms part of a regional north–south wildlife corridor along the coast linking surrounding reserves including Marshalls Creek, Billinudgel, Wooyung and Cudgen nature reserves, as well as a subregional east–west corridor linking the coastal landscape with the escarpment and national parks such as Mount Jerusalem and Nightcap (Scotts & Drielsma 2003). Vegetated links are important as they enable the movement of wildlife, specifically assisting in the maintenance of genetic diversity and long-term viability of native animal populations (Scotts & Drielsma 2003).

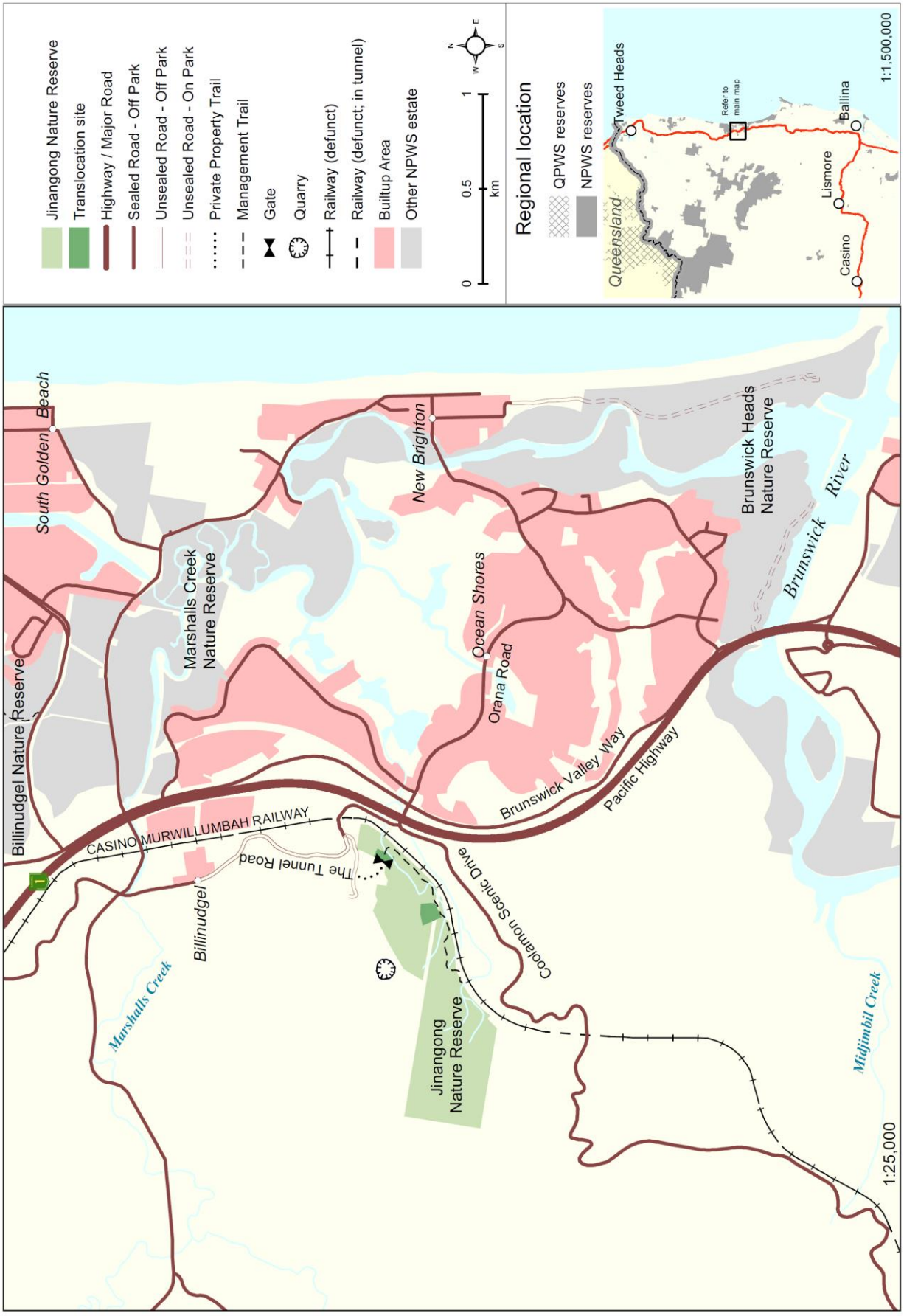
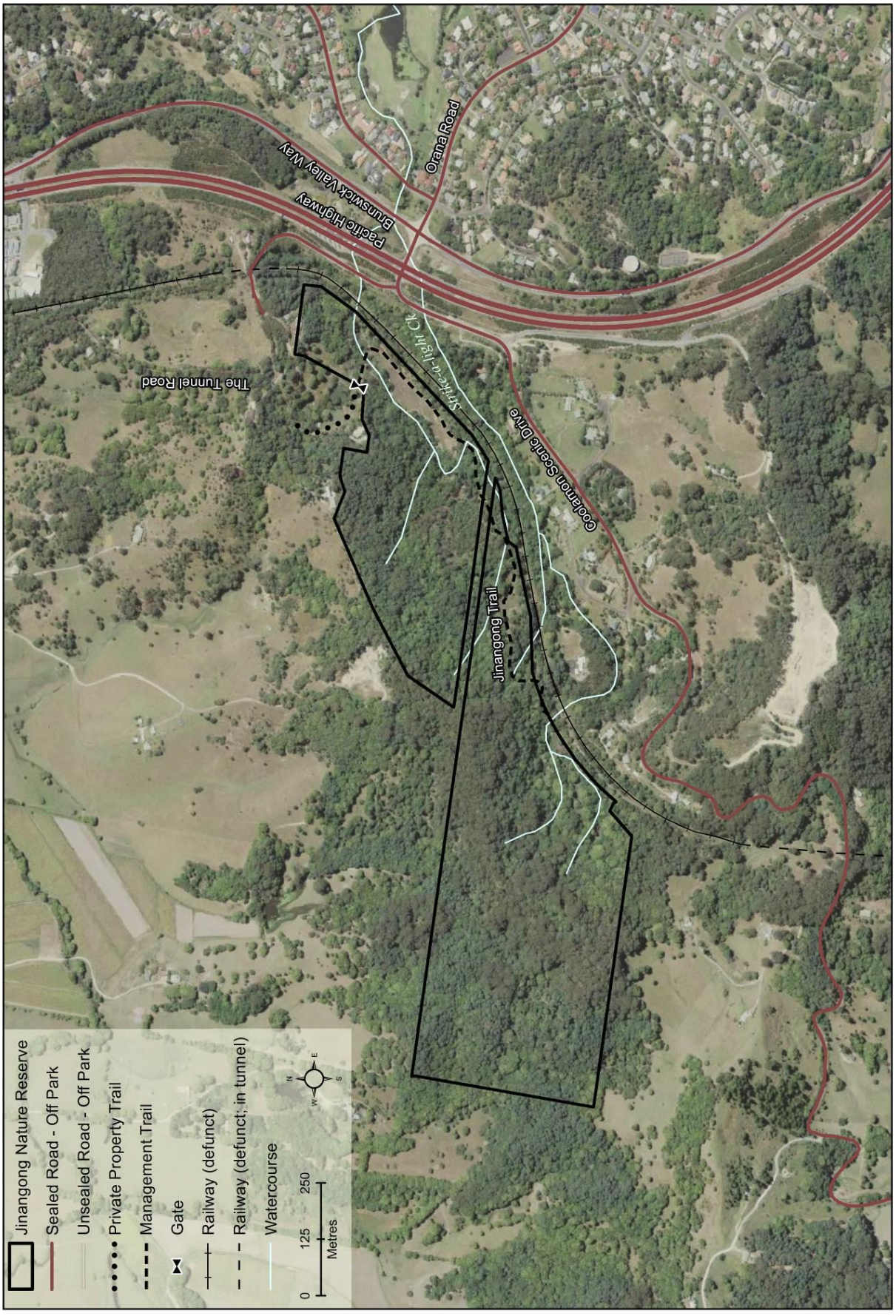


Figure 1: Location of Jinangong Nature Reserve



Aerial photo © Land and Property Information 2009

Figure 2: Aerial photograph of the reserve

As for native plants, strategies for the recovery of threatened species and populations have been set out in the statewide Priorities Action Statement and are prioritised and implemented through the *Saving our Species* program. A species recovery plan has been prepared for the koala under the Threatened Species Conservation Act. A national recovery plan for the grey-headed flying-fox is currently in draft form and is used in combination with relevant strategies from the Priorities Action Statement to manage this species.

Several barbed-wire fences remain throughout the reserve from previous cattle grazing activities. Removal of barbed wire is a priority as native wildlife, such as gliders, owls and flying-foxes, have been known to get caught on such fencing and perish.

Issues

- No systematic study of the reserve's native animal populations has been completed.
- Pest animals compete for habitat and resources and prey on native species (see Section 4.1).
- Habitat isolation and degradation of wildlife corridors may impact animals using the reserve as part of the larger regional wildlife corridor.
- Opportunities exist to rehabilitate and expand habitats within the reserve.
- Barbed-wire fencing is a risk to wildlife.

Desired outcomes

- Populations of significant plant and animal species are conserved.
- Negative impacts on native plants and animals and in particular threatened species are minimised.
- The habitat and populations of native plants and animals and in particular all threatened animals species are protected and maintained.
- Habitat values are restored in degraded areas.
- All barbed-wire fencing within the reserve is removed.

Management response

3.3.1 Implement relevant strategies in the Priorities Action Statement and recovery plans to conserve and recover threatened animal species in the reserve.

3.3.2 Improve habitat values of the reserve through appropriate pest and fire management and by increasing habitat connectivity.

3.3.3 Undertake and/or encourage surveys to increase knowledge of the reserve's native animals and to monitor the effectiveness of restoration programs.

3.3.4 Remove all redundant barbed-wire fencing from within the reserve.

3.4 Aboriginal heritage and historic heritage

Aboriginal heritage

The reserve is within the traditional Country of the Bundjalung People. In the vicinity of the reserve, local clan groups are formally represented by the Tweed Byron Local Aboriginal Land Council and the Bundjalung Council of Elders. The land, water, plants and animals 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, kinship systems and strengthening social

bonds. Aboriginal heritage and connection to nature are inseparable and need to be managed in an integrated manner across the landscape.

The reserve is of cultural importance to the local Aboriginal community. Cultural resources in the reserve include important plants and animals that form a part of the ongoing knowledge sharing, history, cultural practices and stories. Many of the native plant species within the reserve hold cultural value to the local Aboriginal community as important resources for the continuation and sustainability of cultural practices.

Aboriginal sites and places are evidence of Aboriginal occupation and are related to other aspects of Aboriginal culture. They are important as evidence of Aboriginal history and as part of the culture of local Aboriginal people. The reserve has not been formally surveyed for Aboriginal heritage values and there are no records of sites within the reserve. However, the reserve as a natural landscape is important to the local Aboriginal community and it is possible that sites of cultural importance exist within the reserve. In accordance with standard NPWS practice an archaeological survey and cultural assessment will be undertaken before any works with the potential to impact on Aboriginal sites or values.

While the NSW Government has legal responsibility for the protection of Aboriginal sites and places under the National Parks and Wildlife Act, NPWS acknowledges the right of Aboriginal people to make decisions about their own heritage. It is therefore policy that Aboriginal communities be consulted and involved in the management of Aboriginal sites, places and related issues, and the promotion and presentation of Aboriginal culture and history.

Historic heritage

Heritage places and landscapes are made up of living stories as well as connections to the past that can include natural resources, objects, customs and traditions that individuals and communities have inherited and wish to conserve for current and future generations. Cultural heritage comprises places and items that may have historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance.

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 and brothers John and Edward Boyd in 1849. Others followed and large amounts of red cedar (*Toona ciliata*) were felled in the 1860s along with hoop pine (*Araucaria cunninghamii*) and rosewood (*Dysoxylum fraserianum*). Red cedar was lucrative and by the turn of the 20th century most of the accessible stands were gone (Mills 2000). In 1881 the first land selectors arrived in the Brunswick Valley to pursue dairy farming. Large-scale land clearing followed, particularly along the ridge lines and well-drained lowlands (Mills 2000).

Immediately to the east of the reserve is the former site of Hainsville, the first village just north of the Brunswick River. It was named after Maria Hains, who built a small inn for travellers waiting to cross the river. In the 1880s Hainsville had three hotels, several businesses and a school for 109 children. The village prospered from 1891 to 1894 during the construction of the Murwillumbah to Lismore railway line. However, apart from a commemorative plaque nothing remains of the village. In contrast, the village of Billinudgel, 1 kilometre north of the reserve, sprang up around a railway siding at around the same time as Hainsville and remains to this day.

The only vehicular access to the reserve is from the north via The Tunnel Road, which was created in the early 1890s to provide access for workers to construct the Haynes Hill railway tunnel (FL Mills 2008, pers. comm., 21 March). The small watercourse nearby, which partly flows through the reserve, was named ‘Strike-a-light Creek’ at around the same time. During construction of the railway tunnel near the creek, one of the dynamite blasts resulted in water

bursting up through the ground, causing one of the workers to exclaim ‘strike a light!’ (B Mudge 2013, pers. comm., 20 March).

Until 1980 most of the reserve was used for cattle grazing (dairy then beef) and some cropping (e.g. bananas and beans). Some areas were cleared and subject to controlled burning with a number of access roads and house pads constructed. Unauthorised activities by some visitors such as collection of native orchids, epiphytes and rainforest fruits, crayfish trapping, and dumping of household and garden waste continued until the early 2000s. The reserve area is known to some local residents as Jingatee Valley, although the source of this name has not been verified.

In the late 1980s Jack and Hazel Taylor bought a property adjoining what is now the reserve. They immediately recognised the conservation value of the area, with the large rainforest remnant surrounding a clear creek, rare plant species and the eucalypt forests that supported koalas. In 1995 they commissioned a survey of the area’s plants by local rainforest expert Mr Lance Fitzgerald. Within the rainforest remnant Mr Fitzgerald found 11 plant species considered rare or of limited occurrence in New South Wales and a population of *Pararistolochia praevenosa*, a vine that is the sole lowland host of the rare Richmond birdwing butterfly (*Ornithoptera richmondia*). He also found the subtropical rainforest remnant was significant due to its lack of disturbance.

In 1996 the then RTA announced the commencement of the Brunswick Heads to Yelgun Pacific Highway upgrade. The RTA proposed a number of options for the new highway including the ‘western’ route that passed through the valley. Even though this route option would not have gone through the rainforest it would have changed the microclimate by exposing the forest to easterly winds (J Taylor 2012, pers. comm., 19 June). The Taylors wrote to NPWS in 1996 about the significance of the area, requesting it be acquired and protected as a nature reserve or national park. Subsequent flora surveys conducted by John Hunter from NPWS and for the RTA (Gunninah Environmental Consultants 1998) confirmed its high conservation value, and discovered more threatened species.

The Taylors joined the Brunswick Catchment/Forest Landcare Group (now called ‘Brunswick Valley Landcare’) in the late 1990s and together with other members, particularly Dr Joanne Green, persistently lobbied for the ongoing protection of the site. They also organised monthly volunteer bush regeneration days to control weeds, plant trees and collect rubbish, often with assistance from NPWS. Several of those original volunteers continue to work in the reserve every month on bush regeneration programs.

The rainforest remnant straddled two private properties. In 2000 the RTA bought the properties for future dedication to the reserve system as part of a compensatory habitat package for impacts associated with the Brunswick Heads to Yelgun Pacific Highway upgrade. After the land purchase, the RTA submitted a development application to Byron Shire Council to excise the two houses on the northern boundary from the proposed reserve. An environmental management plan was prepared as part of the approval process to subdivide the northern blocks (DEC 2005).

While a formal systematic survey to determine the existence of any sites of historic heritage has not been conducted in the reserve, based on the available evidence it is unlikely that they occur.

Issue

- No systematic survey of cultural values has been completed within the reserve.

Desired outcomes

- Significant Aboriginal places and values are identified and protected.

- Aboriginal people are involved in management of the Aboriginal cultural values of the reserve.
- Understanding of the cultural values of the reserve is improved.

Management response

3.4.1 Continue to consult and involve the Tweed Byron Local Aboriginal Land Council, the Bundjalung Council of Elders, other relevant Aboriginal community organisations and custodial families in the management of the reserve.

3.4.2 Undertake an archaeological survey and cultural assessment before all works with the potential to impact Aboriginal sites or values.

3.4.3 Encourage further research into the Aboriginal cultural heritage values of the park with the Tweed Byron Local Aboriginal Land Council, Bundjalung Council of Elders and other relevant Aboriginal community organisations.

3.5 Visitor use

NPWS parks and reserves provide a range of visitor opportunities. NPWS aims to ensure that visitors enjoy, experience and appreciate the parks while park values are conserved and protected.

The reserve has very low levels of visitation as there is no public vehicle road access to or within the reserve. NPWS has a right of carriageway over private land to the northern entrance of the reserve. The right of carriageway provides legal access for NPWS to access the reserve for management purposes only but does not allow public vehicle access for recreation. While recreational opportunities are restricted, the current neighbours support access for volunteers to be involved in bush regeneration activities (see Section 4.1). Access is also possible on community information days, which are held occasionally.

Other NPWS reserves located nearby, including Brunswick Heads Nature Reserve, Marshalls Creek Nature Reserve and Cape Byron State Conservation Area, provide opportunities for a range of visitor activities including picnicking, canoeing, birdwatching, fishing, bushwalking and cycling.

Horse riding and cycling are not appropriate activities in Jinangong Nature Reserve due to the specific conservation requirements of this category of reserve (see Section 2.2), and the lack of any suitable roads and access.

Issues

- There is no public vehicle access to the reserve.
- With restricted access there is limited potential for visitor use.

Desired outcome

- Visitor use of the reserve is appropriate, low-impact and ecologically sustainable.

Management response

3.5.1 Promote visitor appreciation and awareness of the reserve's values through community involvement in bush regeneration activities, information days and other similar activities as appropriate.

3.5.2 Limit visitor use and access to the reserve to organised group activities for the purpose of conservation and educational activities only. Organised group activities for this purpose will be permitted for up to a maximum of 20 people.

4. Threats

4.1 Pests

Pest species are plants and animals that have negative environmental, economic and social impacts; commonly they are introduced species. Pests can have impacts across the range of park values, including impacts on biodiversity, cultural heritage, catchment and scenic values. The relatively small size of the reserve results in a high edge-to-area ratio, which allows increased wind and light penetration that eliminates many native rainforest species and enables weed species to establish (Winter et al. 1984 in Joseph 2002).

The NPWS *Regional Pest Management Strategy 2012–17, Northern Rivers Region* (OEH 2012a) identifies pest species across the region's parks and details priorities for control, including actions listed in the Priorities Action Statement and threat abatement plans and other strategies, such as the NSW *Biodiversity Priorities for Widespread Weeds* (NSW DPI & OEH 2011) and the *NSW Biosecurity Strategy 2013–2021* (DPI 2013). The overriding objective of the pest management strategy is to minimise adverse impacts of introduced species on biodiversity and other park and community values while complying with legislative responsibilities. The pest management strategy identifies a number of pest species as occurring, or likely to occur, within the reserve.

Several weed control strategies have been prepared for the reserve to guide regeneration works (Bailey 2010; Joseph 2002; Wilson 2001). Over 30 environmental weed species have been recorded in the reserve. Some of these weeds are also declared noxious under the *Noxious Weeds Act 1993.* Lantana is prolific in the reserve and is declared noxious as well as being a Weed of National Significance and listed under the Threatened Species Conservation Act as a key threatening process to the rainforest communities and several species within the reserve. Some of the most problematic environmental weeds found in the reserve are listed below in Table 3.

Table 3: Significant environmental weeds recorded in the reserve

Common Name	Scientific Name
Crofton weed	*Ageratina adenophora* *
Mistflower	*Ageratina riparia* *
Camphor laurel	*Cinnamomum camphora* *
Blue morning glory	*Ipomoea indica*
Lantana	*Lantana camara* * ^ ~
Small-leaved privet	*Ligustrum sinense* *
Molasses grass	*Melinis minutiflora*
Broadleaf paspalum	*Paspalum mandiocanum*
Umbrella tree	*Schefflera actinophylla*
Singapore daisy	*Sphagneticola trilobata*

Key: * Declared noxious; ^ Weed of National Significance; ~ Key threatening process

Since the late 1990s local residents and members of Brunswick Valley Landcare have conducted weed control and tree planting in what is now the reserve. A small dedicated group of volunteers continue to do bush regeneration work in the reserve once a month and assist with occasional community information days.

Introduced pest animals recorded in the reserve are the cane toad (Rhinella marina), European red fox (Vulpes vulpes*)*, feral cats *(*Felis catus*)* and wild dogs (Canis lupus familiaris*).* All four of these pest animals are part of key threatening processes listed under the Threatened Species Conservation Act due to their impacts on native species. Due to the close proximity of urban areas there is also a significant threat to the reserve's native wildlife from roaming domestic dogs and cats through predation, competition for food and shelter, or by disturbance caused by their presence or scent.

Myrtle rust is a plant disease caused by the exotic fungus *Uredo rangelii* and first detected in Australia in 2010. It now occurs in many parts of coastal eastern Australia, and is present in the reserve. The known occurrence in the reserve is obvious and easily accessible. The *Management Plan for Myrtle Rust on the National Parks Estate* (OEH 2011) outlines how myrtle rust will be managed in NPWS parks and reserves, and incorporates strategies to limit the spread of myrtle rust and minimise impacts to threatened species and ecological communities. The long-term effect of the pathogen on native plants and native ecosystems is still unknown.

Desired outcomes

- Pest plants and animals are controlled and where possible eliminated.
- Negative impacts of pest plants and animals on reserve values are minimised.
- An understanding of myrtle rust's long-term impacts is improved.

Management response

4.1.1 Manage pest species in accordance with the regional pest management strategy, relevant threat abatement plans and Priorities Action Statement.

4.1.2 Monitor pest animals within the reserve to determine the presence and extent of pest species and identify biodiversity most at risk.

4.1.3 Undertake pest species control in cooperation with the Brunswick Valley Landcare Group, reserve neighbours, Byron Shire Council, and North Coast Local Land Services.

4.1.4 Monitor noxious and significant environmental weeds and their impacts. Treat any new outbreaks where possible.

4.1.5 Manage myrtle rust in the reserve in accordance with the *Management Plan for Myrtle Rust on the National Parks Estate*.

4.1.6 Monitor the extent and intensity of myrtle rust in the reserve with photographs and recorded observations.

4.2 Fire

The primary objectives of NPWS fire management are to protect life, property, community assets and cultural heritage from the adverse impacts of fire, while managing fire regimes in parks to maintain and enhance biodiversity. NPWS also assists in developing fire management practices that contribute to conserving biodiversity and cultural heritage across the landscape, and implements cooperative and coordinated fire management arrangements with other fire authorities, neighbours and the community (OEH 2013a).

Fire is a natural feature of many environments and is essential for the survival of some plant communities. However, inappropriate fire regimes can lead to loss of particular plant and animal species and communities, and high frequency fires have been listed as a key threatening process under the Threatened Species Conservation Act.

The documented fire history for the reserve before its reservation is limited; however, available records and anecdotal information suggest a relatively low to moderate frequency of small prescribed burns in the recent past (J Taylor 2012, pers. comm., 19 June). Some vegetation communities within the reserve, such as the lowland rainforest and wet sclerophyll forests, are very sensitive to fire. Threatened species such as the rose-crowned fruit-dove have been identified as being threatened by fire in rainforest remnants. Managing the impacts of fire within the reserve will therefore be focused on suppression of wildfire.

A fire management strategy has been prepared for the reserve and other nearby reserves (NPWS 2013). The fire management strategy outlines the recent fire history of the reserve, key assets adjoining the reserve, fire management zones and fire control advantages such as management trails and water supply points. It also contains fire regime guidelines for conservation of the reserve's vegetation communities.

NPWS maintains cooperative arrangements with surrounding landowners and the Rural Fire Service and is actively involved with the Far North Coast Bush Fire Management Committee. Cooperative arrangements include fire planning, fuel management and information sharing. Hazard reduction programs, ecological burning proposals and fire trail works are submitted annually to the Bush Fire Management Committee.

Desired outcomes

- Negative impacts of fire on life, property and the environment are minimised.
- The potential for spread of bushfires on, from, or into the reserve is minimised.
- Fire regimes are appropriate for conservation of the reserve's native plant and animal communities.

Management response

4.2.1 Implement the reserve fire management strategy.

4.2.2 Continue to be involved in the Far North Coast Bush Fire Management Committee and maintain cooperative arrangements with local Rural Fire Service brigades and other fire authorities and surrounding landowners in regard to fuel management and fire suppression.

4.3 Climate change

Climate change has been listed as a key threatening process under the Threatened Species Conservation Act. Projections of future changes in climate for the north coast of New South Wales (DECCW 2010b) include an increase in average daily minimum temperatures in all seasons. It is likely that rainfall will increase in summer and autumn and that evaporation will increase in all seasons leading to drier conditions for most of the year. Rises in sea level and catchment-driven flooding are likely to lead to an increase in flooding on the lower portion of coastal floodplains.

Higher temperatures and changes to rainfall patterns are likely to lead to increased fire frequency towards the year 2050, but the return period of fires is considered likely to remain within the current domain of acceptable fire intervals of 5–30 years across the majority of the region. Wetter forests, including rainforests that currently experience little or no fire, could be affected by an increase in fire activity under future conditions of increased fire danger. Fire dangers in the region currently peak in spring and summer and an extension into late winter is possible (DECCW 2010b).

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 and pressure from feral animals. Ecosystems such as lowland subtropical rainforest on the NSW north coast are susceptible to increased pressure from changes in fire, weed pressure and changes in moisture levels.

Programs to reduce the pressures arising from other threats, such as habitat fragmentation, invasive species and bushfires, will help reduce the severity of the effects of climate change (see Sections 4.1 and 4.2).

Desired outcome

- The effects of climate change on natural systems are minimised.

Management response

4.3.1 Continue existing fire, pest and weed management programs to increase the reserve's ability to cope with future disturbances, including climate change, and encourage research into appropriate indicators to monitor the effects of climate change.

5. Implementation

This plan of management establishes a scheme of operations for the reserve. Implementation of this plan will be undertaken within the annual program of the NPWS Northern Rivers Region.

Identified activities for implementation are listed in Table 4. Relative priorities are allocated against each activity as follows:

- **High** priority activities are imperative to achieving the plan's objectives and desired outcomes, and must be undertaken in the near future to avoid significant deterioration in natural, cultural or management resources.
- **Medium** priority activities are necessary to achieve the objectives and desired outcomes but are not urgent.
- **Low** priority activities are desirable to achieve the objectives and desired outcomes but can wait until resources become available.
- **Ongoing** activities are undertaken on an annual basis or in response to an issue that arises.

This plan of management does not have a specific term and will stay in force until amended or replaced in accordance with the National Parks and Wildlife Act.

List of management responses

Management response	Priority
3.1 Geology, landscape and hydrology	
3.1.1 Restore vegetation communities in disturbed areas as much as possible and implement bush regeneration programs to control weed species to reduce soil erosion and runoff.	Medium
3.2 Native plants	
3.2.1 Implement relevant strategies in the Priorities Action Statement and recovery plans for threatened plant species, populations and ecological communities present in the reserve, including appropriate pest and fire management and monitoring of the translocated hairy quandongs.	High
3.2.2 Restore native vegetation communities through weed control, replanting and/or promoting natural regeneration.	Medium
3.2.3 Support the involvement of volunteer groups in habitat restoration programs.	High
3.2.4 Monitor vegetation cover in the reserve, particularly in disturbed areas and areas subject to replanting, so the effectiveness of regeneration activities can be assessed.	Low
3.3 Native animals	
3.3.1 Implement relevant strategies in the *Priorities Action Statement* and recovery plans to conserve and recover threatened animal species in the reserve.	High
3.3.2 Improve habitat values of the reserve through appropriate pest and fire management and by increasing habitat connectivity.	Ongoing
3.3.3 Undertake and/or encourage surveys to increase knowledge of the reserve's native animals and to monitor the effectiveness of restoration programs.	Low
3.3.4 Remove all redundant barbed-wire fencing from within the reserve.	High

Management response	Priority
3.4 Aboriginal heritage	
3.4.1 Continue to consult and involve the Tweed Byron Local Aboriginal Land Council, the Bundjalung Council of Elders, other relevant Aboriginal community organisations and custodial families in the management of the reserve.	High
3.4.2 Undertake an archaeological survey and cultural assessment before all works with the potential to impact Aboriginal sites or values.	Ongoing
3.4.3 Encourage further research into the Aboriginal cultural heritage values of the park with the Tweed Byron Local Aboriginal Land Council, Bundjalung Council of Elders and other relevant Aboriginal community organisations.	Medium
3.5 Visitor use	
3.5.1 Promote visitor appreciation and awareness of the reserve's values through community involvement in bush regeneration activities, information days and other similar activities as appropriate.	Low
3.5.2 Limit visitor use and access to the reserve to organised group activities for the purpose of conservation and educational activities only. Organised group activities will be permitted for up to a maximum of 20 people.	Ongoing
4.1 Pests	
4.1.1 Manage pest species in accordance with the regional pest management strategy, relevant threat abatement plans and Priorities Action Statement.	Ongoing
4.1.2 Monitor pest animals within the reserve to determine the presence and extent of pest species and identify biodiversity most at risk.	Ongoing
4.1.3 Undertake pest species control in cooperation with the Brunswick Valley Landcare Group, reserve neighbours, Byron Shire Council, and North Coast Local Land Services.	High
4.1.4 Monitor noxious and significant environmental weeds and their impacts. Treat any new outbreaks where possible.	Ongoing
4.1.5 Manage myrtle rust in the reserve in accordance with the *Management Plan for Myrtle Rust on the National Parks Estate*.	Ongoing
4.1.6 Monitor the extent and intensity of myrtle rust in the reserve with photographs and recorded observations	Low
4.2 Fire	
4.2.1 Implement the reserve fire management strategy.	High
4.2.2 Continue to be involved in the Far North Coast Bush Fire Management Committee and maintain cooperative arrangements with local Rural Fire Service brigades and other fire authorities and surrounding landowners in regard to fuel management and fire suppression.	High
4.3 Climate change	
4.3.1 Continue existing fire, pest and weed management programs to increase the reserve's ability to cope with future disturbances, including climate change, and encourage research into appropriate indicators to monitor the effects of climate change.	Ongoing

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