

**FLAGGY CREEK AND TALLAWUDJAH NATURE
RESERVES**

PLAN OF MANAGEMENT

NSW National Parks and Wildlife Service

Part of the Department of Environment and Conservation (NSW)

June 2004

This plan of management was adopted by the Minister for the Environment on 29th June 2004.

Acknowledgments

This plan is based on a draft plan prepared by NPWS Clarence South Area staff, with assistance from North Coast Regional staff and the Northern Directorate Planning Group.

Thanks are extended to all members of the community who participated in the consultation process.

Cover photographs by Andrew Lugg and Shane Ruming, NPWS.

Further information

For additional information or enquiries on any aspect of the plan, contact the NPWS Clarence South Area Office at Level 3, 49 Victoria Street (PO Box 361), Grafton NSW 2460, or by phone on (02) 6641-1500.

© **Department of Environment and Conservation (NSW) 2004:** Use permitted with appropriate acknowledgment

ISBN 0 7313 6857 6

FOREWORD

Flaggy Creek and Tallawudjah Nature Reserves are located in the Clarence Valley, on the north coast of NSW. Flaggy Creek Nature Reserve is located approximately seven kilometres north of Glenreagh, on the Orara Way. Tallawudjah Nature Reserve is located west of Flaggy Creek Nature Reserve, approximately seven kilometres north-west of Glenreagh.

The reserves comprise hilly terrain breached by wide valleys with major streams. Tallawudjah Nature Reserve displays an undulating landscape featuring contrasting ridges, plateaus and gullies, and several prominent sandstone escarpments. The escarpments in this area have been likened to those of the Sydney area. Flaggy Creek Nature Reserve has a gentler sloping terrain, with a mostly north-east aspect.

Flaggy Creek and Tallawudjah Nature Reserves protect areas of mostly dry sclerophyll forest. Tallawudjah Nature Reserve contains extensive areas of high quality old growth forest, and conserves at least ten forest ecosystems and core habitat for several threatened fauna and flora species. It has been identified as a centre of endemism for vascular plants of the Kangaroo Creek Sandstone complex. Flaggy Creek Nature Reserve also occupies part of the Kangaroo Creek sandstone centre of endemism for vascular plants. A diversity of forest communities exist within this reserve, with heathlands occurring on sandy soils, wet sclerophyll forest along Flaggy Creek, and dry sclerophyll forest on drier slopes.

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

A draft plan of management for Flaggy Creek and Tallawudjah Nature Reserves was placed on public exhibition from 27 June until 10 October 2003. The exhibition of the plan of management attracted 3 submissions that raised 11 issues. All submissions received were carefully considered before adopting this plan of management.

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

BOB DEBUS

MINISTER FOR THE ENVIRONMENT

1. NATURE RESERVES IN NEW SOUTH WALES

1.1 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 NPW Regulations, 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 arise from 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) requires the assessment and mitigation of environmental impacts of any works proposed in this plan.

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

1.2 MANAGEMENT PURPOSES AND PRINCIPLES

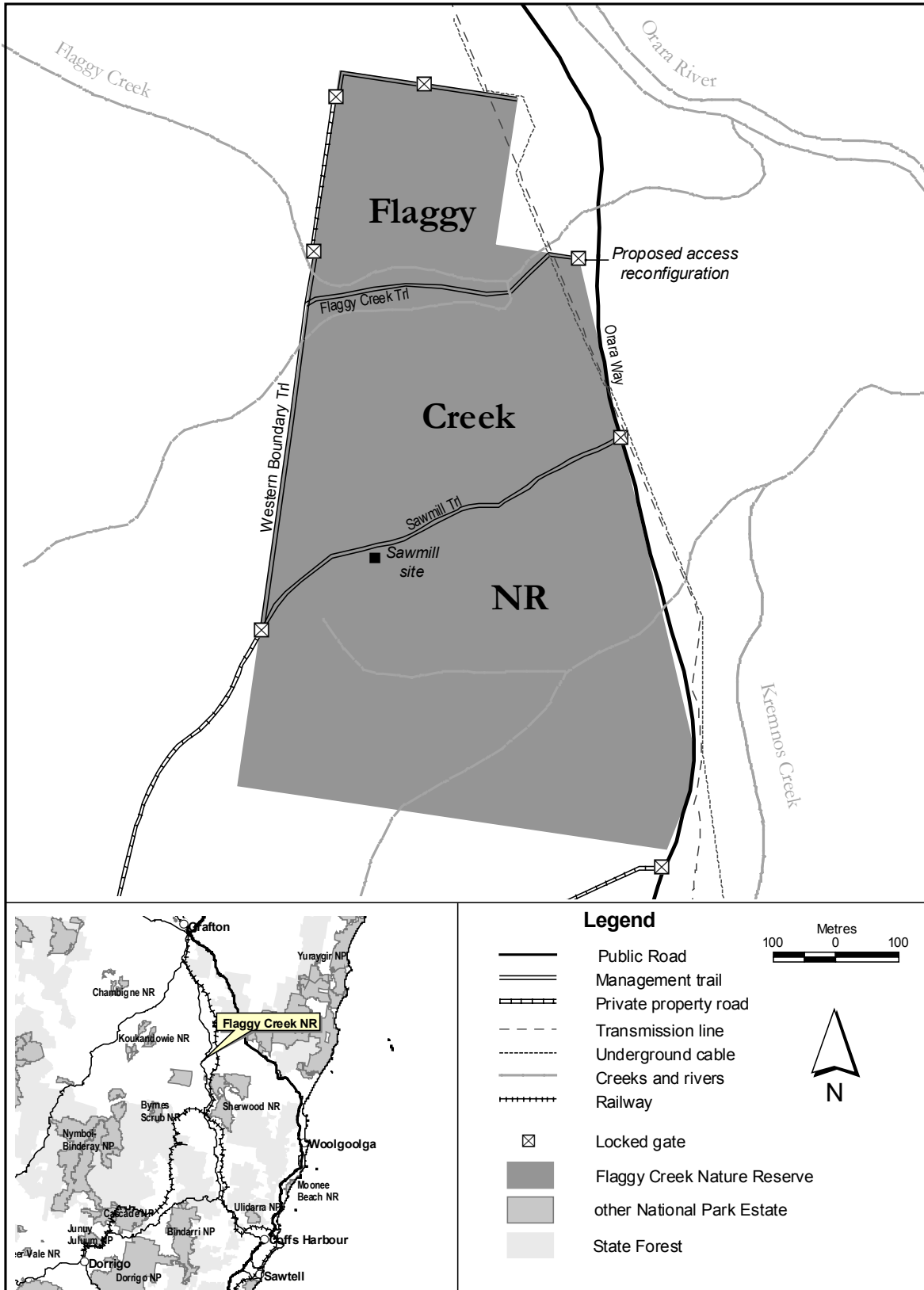
Nature reserves are reserved under the NPW Act to protect and conserve areas containing outstanding, unique or representative ecosystems, species, communities or natural phenomena.

Nature reserves are to be managed to:

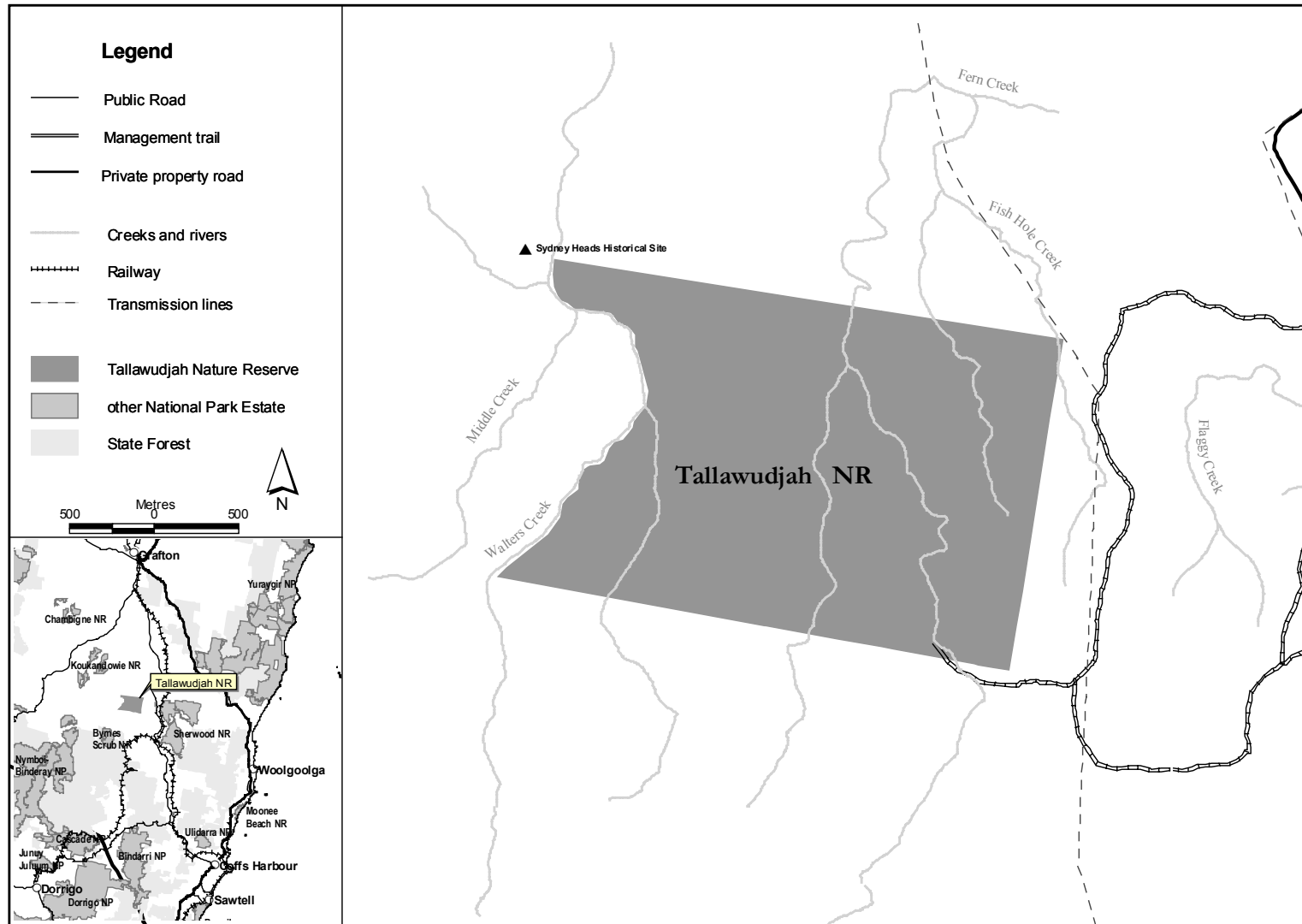
- conserve biodiversity, maintain ecosystem functions, and protect geological and geomorphological features and natural phenomena;
- conserve places, objects, features and landscapes of cultural value;
- promote public appreciation, enjoyment and understanding of the reserve's natural and cultural values;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

Nature reserves are valuable refuge areas, where natural processes, phenomena and wildlife can be studied. They differ from national parks, which include as a major objective the provision of appropriate recreation opportunities. Nature reserves are part of the regional pattern of land use. Management of nature reserves aims to minimise disturbance to natural and cultural heritage. Other land uses, for example agriculture, forestry and mining, are distinguished by an acceptance or encouragement of environmental modification. Nature reserves, therefore, provide for only a limited part of the range of land uses in a region.

2. RESERVES AND LOCALITY MAPS



Map 1: Flaggy Creek Nature Reserve and locality



Map 2: Tallawudjah Nature Reserve and locality

3. FLAGGY CREEK AND TALLAWUDJAH NATURE RESERVES BASIS FOR MANAGEMENT

3.1 LOCATION, GAZETTAL AND REGIONAL SETTING

Flaggy Creek and Tallawudjah Nature Reserves (collectively referred to herein as 'the reserves', or 'the planning area') are located in the Clarence Valley, on the north coast of NSW (see Maps 1 and 2). Flaggy Creek Nature Reserve is located approximately seven kilometres north of Glenreagh, on the Orara Way. Tallawudjah Nature Reserve is located west of Flaggy Creek Nature Reserve, approximately seven kilometres north-west of Glenreagh.

Flaggy Creek Nature Reserve and Tallawudjah Nature Reserve were gazetted on 17 December 1999 and comprise approximately 72 hectares and 1247 hectares respectively. Prior to gazettal, the reserves were classified as vacant Crown Land. The entire area of both reserves was for many years subject to Permissive Occupancy Licences for grazing, which expired in June 2000, following gazettal. However, neither of the reserves appear to have been used for grazing in recent years, despite the existence of these licences.

The reserves adjoin private freehold land, which is largely forested and forms part of a vegetated corridor linking the reserves to other conservation areas, including Sherwood Nature Reserve to the east and Byrnes Scrub and Koukandowie Nature Reserves to the west.

The reserves are within the boundaries of the Pristine Waters Local Government Area. The Grafton Rural Lands Protection Board and the Upper North Coast Catchment Management Board relate to the geographic area that the reserves fall within. The reserves and surrounding areas are of high cultural significance to the Grafton-Ngerrie Local Aboriginal Land Council and Gumbaynggirr people.

Regional Forest Agreements

Regional Forest Agreements (RFA) are one of the principal means of implementing the National Forest Policy Statement of 1992. Under this Statement Commonwealth, State and Territory governments agreed to work towards a shared vision for Australia's forests to maintain native forest estate, manage it in an ecologically sustainable manner and develop sustainable forest-based industries. The Statement provided for joint comprehensive assessments of the natural, cultural, economic and social values of forests. These assessments formed the basis for negotiation of Regional Forest Agreements that provide, amongst other things, for Ecologically Sustainable Forest Management.

The North East RFA covers the planning area. The process leading up to the RFA provided for major additions to the reserve system, including the establishment of Flaggy Creek and Tallawudjah Nature Reserves.

3.2 LANDSCAPE CONTEXT

Natural and cultural heritage and on-going use are strongly inter-related and together form the landscape of an area. Much of the Australian environment has been influenced by past Aboriginal and non-Aboriginal land use practices and the activities of modern day Australians continue to influence bushland through recreational use, cultural practices, the presence of introduced plants and animals and, in some cases, air and water pollution.

Flaggy Creek and Tallawudjah Nature Reserves protect areas of mostly dry sclerophyll forest on Kangaroo Creek Sandstone geology. The undulating terrain feeds into several creek systems within the reserves, which in turn flow into the Orara River. Sandstone escarpments are a prominent feature of Tallawudjah Nature Reserve.

The geology, landform, climate and plant and animal communities of the area, plus its location, have determined how it has been used by humans. Much of the area has been logged in the past for hardwood timbers, particularly on the gentler and more accessible slopes such as those occurring within Flaggy Creek Nature Reserve. Cattle grazing and fire have also shaped the landscape. Flaggy Creek Nature Reserve contains several disturbed areas dating back to its use as a former sawmill operation, such as trails, cleared areas and a dam. Tallawudjah Nature Reserve has undergone far less modification, with large areas of old growth forest remaining.

Travelling Aborigines used the general area in which the reserves are located. Evidence also points to a level of more permanent occupation and use of the lands by Aboriginal families (Navin and Officer 1990).

Both Aboriginal and non-Aboriginal people place cultural values on natural areas, including aesthetic, social, spiritual, recreational and other values. Cultural 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. This plan of management aims to conserve both natural and cultural values. For reasons of clarity and document usefulness natural and cultural heritage, non-human threats and on-going use are dealt with individually, but their inter-relationships are recognised.

3.3 MANAGEMENT DIRECTIONS

The following specific objectives apply to the management of Flaggy Creek and Tallawudjah Nature Reserves:

- management of the reserves as part of a regionally important system of protected areas;
- conservation of plant species and communities representative of the Kangaroo Creek Sandstone and Walloon Coal Measure geological formations;
- protection of plant species endemic to the Kangaroo Creek Sandstone geology, including the threatened hairy melichrus (*Melichrus hirsutus*) and sandstone rough-barked apple (*Angophora robur*);

- protection of habitat for significant plants and animals, including species and populations that are:
 - listed under the TSC Act or the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act);
 - endemic or regionally significant;
 - otherwise rare or threatened; or
 - at the limits of their known distribution.
- provision of opportunities for self-reliant nature-based recreation only; and
- restriction of further non-NPWS infrastructure within the reserves.

3.4 NATURAL AND CULTURAL HERITAGE

Landform, Hydrology, Geology and Soils

The reserves comprise hilly terrain breached by wide valleys with major streams. Tallawudjah Nature Reserve displays an undulating landscape featuring contrasting ridges, plateaus and gullies, and several prominent sandstone escarpments. The escarpments in this area have been likened to those of the Sydney area, and are known locally as Sydney Heads. Sideslopes of greater than 30 degrees are common along ridge lines. Most of the reserve, however, contains slopes of between 20 and 30 degrees. Elevation ranges from 80 m to 300 m above sea level.

Flaggy Creek Nature Reserve has a gentler sloping terrain, with a mostly north-east aspect and sideslopes of 20 to 25 degrees. Lower lying areas contain slopes of less than 15 degrees. Elevation ranges from 45 m at Flaggy Creek to a ridge at 110 m.

The reserves occur in the Mid Orara River Sub-catchment of the Clarence River. Several streams flow through the reserves to the north and east, including Flaggy Creek and an unnamed tributary to Kremnos Creek (within Flaggy Creek Nature Reserve) and Black Swamp Creek and a tributary to Fish Hole Creek (within Tallawudjah Nature Reserve). Walters Creek (becoming Middle Creek) runs along the western boundary of Tallawudjah Nature Reserve.

The reserves lie near the southern edge of the Clarence-Moreton sedimentary basin. The majority of the reserves lie within the Middle Jurassic Kangaroo Creek Sandstone geological formation, where the landscape is characterised by medium to coarse sandstone with infertile shallow loams (Riddler and Hawkins 1981, SFNSW 1995). Sedimentary rocks of the Middle Jurassic Walloon Coal Measures, which reach their southern extent within the Clarence-Moreton Basin in the Glenreagh area (McElroy 1969), occur within Tallawudjah Nature Reserve. The northern section of Flaggy Creek Nature Reserve is situated on the Late Jurassic Grafton Formation (Riddler and Hawkins 1981, SFNSW 1995).

The reserves contain several soil landscapes and are characterised by yellow to yellow/grey podsolics derived from sandstone and conglomerate. These soils are generally of low fertility (Forestry Commission of NSW 1984). The Kremnos erosional soil landscape occurs on sideslopes, and is the major soil landscape within both Tallawudjah and Flaggy Creek Nature Reserves. A moderate potential topsoil erosion

hazard and a high potential subsoil erosion hazard are experienced within this soil landscape. A brief description of the soil landscapes of the reserves and their potential for erosion is provided in Section 3.8 *Soil erosion* and *Appendix B*.

Native plants

Tallawudjah Nature Reserve contains extensive areas of high quality old growth forest, and conserves at least ten forest ecosystems and core habitat for several threatened fauna and flora species. The majority of the reserve consists of Sherwood needlebark stringybark (*Eucalyptus planchoniana*) and Baileys stringybark (*E. baileyana*) forest ecosystems, with smaller occurrences of other ecosystems, including needlebark stringybark–large fruited blackbutt (*E. pyrocarpa*), dry heathy sandstone blackbutt (*E. pilularis*), dry grassy blackbutt-tallowwood (*E. pilularis*–*E. microcorys*), dry heathy blackbutt–bloodwood (*E. pilularis*–*Corymbia gummifera*) and Clarence lowland needlebark stringybark (NPWS 1999). The reserve exhibits a diverse sample of vulnerable old growth ecosystems, including those mentioned above.

The unique environment of the reserve also supports the bastard white mahogany (*Eucalyptus psammitica*) and white bloodwood (*Corymbia trachyphloia*) forest association, which appears to be restricted to sandstones in the Coffs Harbour area.

Tallawudjah Nature Reserve has been identified as a centre of endemism for vascular plants of the Kangaroo Creek Sandstone complex (NPWS 1999a; Resource and Conservation Assessment Council 1996), where the overall probability of occurrence is high for plants that are endemic to this geology.

Eight significant plants have been recorded in the reserve, including two listed under the TSC Act (refer to *Table 1*). These two plants are also listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Moonee quassia (*Quassia* sp. 'Moonee Creek'), bastard white mahogany, square-fruited ironbark (*Eucalyptus tetrapleura*), red-leaved daisy bush (*Olearia stilwelliae*) and *Homoranthus floydii* are all endemic to the area.

Flaggy Creek Nature Reserve also occupies part of the Kangaroo Creek sandstone centre of endemism for vascular plants. A diversity of forest communities exist within the reserve, with heathlands occurring on sandy soils, wet sclerophyll forest along Flaggy Creek, and dry sclerophyll forest on drier slopes. The dominant forest ecosystems occurring within the reserve include Sherwood needlebark stringybark, dry heathy blackbutt-bloodwood, foothill grey gum-ironbark-spotted gum (*E. propinqua*–*E. siderophloia*–*C. variegata*), needlebark stringybark-large fruited blackbutt and Baileys stringybark (NPWS 1999). Other ecosystems include Clarence lowland needlebark stringybark and the rare swamp and banksia forest ecosystems. Many of these forest ecosystems are in old growth condition.

Habitat models produced for the reserves during the Comprehensive Regional Assessment (CRA) process predict the occurrence of suitable habitat for several significant species within the reserves, including eight listed under the TSC Act (refer to *Table 1*).

High quality core habitat for the endangered shrub hairy melichrus (*Melichrus hirsutus*) occurs within both Flaggy Creek and Tallawudjah Nature Reserves, and the plant has been recorded within both reserves. This plant has only recently been described and its presence is a significant natural feature of the reserves.

The NPWS Key Habitats and Corridors project (NPWS 2001) identified Flaggy Creek and Tallawudjah Nature Reserves as occupying part of a regional vegetation corridor for fauna movement, which links Sherwood Nature Reserve and other forest habitats to the north-east with NPWS and State Forest estate to the south-west. Tallawudjah Nature Reserve also forms part of a corridor linking the area to vegetated land to the north of the reserve, including other nature reserves. Vegetated private lands surrounding the reserves are vital to the connectivity of fauna habitats in the region.

The high quality forest communities of the Tallawudjah and Flaggy Creek Nature Reserves are likely to support a diverse range of rare and threatened fauna species, including those listed in *Table 2* (refer to *Native Fauna*) and *Appendix A*.

Table 1 Significant plants known or likely to occur in the reserves

Species known to occur within the reserves			
Common name	Scientific name	Status	Reserve
hairy melichrus	<i>Melichrus hirsutus</i>	Endangered [#]	Both
sandstone rough-barked apple	<i>Angophora robur</i>	Vulnerable [#]	Tallawudjah
–	<i>Homoranthus floydii</i>	ROTAP 2RC-t	Tallawudjah
–	<i>Dodonaea hirsuta</i>	ROTAP 3RC-	Tallawudjah
red-leaved daisy bush	<i>Olearia stilwelliae</i>	ROTAP 3RCa	Tallawudjah
tapering-leaved bottlebrush	<i>Callistemon acuminatus</i>	ROTAP 3RC-	Tallawudjah
giant lily	<i>Doryanthes excelsa</i>	Regionally significant	Tallawudjah
–	<i>Pultenaea</i> sp. J ('robusta')	Regionally significant	Tallawudjah
Species considered likely to occur to occur within the reserves			
Moonee quassia	<i>Quassia</i> sp. 'Moonee Creek'	Endangered [#]	Tallawudjah
square-fruited ironbark	<i>Eucalyptus tetrapleura</i>	Vulnerable [#]	Both
–	<i>Lindsaea incisa</i>	Endangered	Both
sandstone rough-barked apple	<i>Angophora robur</i>	Vulnerable [#]	Flaggy Ck
Rupp's wattle	<i>Acacia ruppii</i>	Endangered [#]	Tallawudjah
–	<i>Triplarina imbricata</i>	Endangered [#]	Tallawudjah
Tinospora vine	<i>Tinospora smilacina</i>	Endangered	Tallawudjah
milky silkpod	<i>Parsonsia dorrigoensis</i>	Vulnerable	Tallawudjah
tapering-leaved bottlebrush	<i>Callistemon acuminatus</i>	ROTAP 3RC-	Flaggy Ck
red-leaved daisy bush	<i>Olearia stilwelliae</i>	ROTAP 3RCa	Flaggy Ck
–	<i>Homoranthus floydii</i>	ROTAP 2RC-t	Flaggy Ck

Table 2 (continued) Significant plants known or likely to occur in the reserves

Species considered likely to occur within the reserves (continued)			
Common name	Scientific name	Status	Reserve
–	<i>Dodonaea hirsuta</i>	ROTAP 3RC-	Flaggy Ck
bastard white mahogany	<i>Eucalyptus psammitica</i>	ROTAP 3K	Both
–	<i>Paspalidium grandispiculatum</i>	ROTAP 3V	Both
–	<i>Boronia chartacea</i>	ROTAP 3R	Tallawudjah
long-tailed greenhood	<i>Pterostylis woollsii</i>	ROTAP 3RC-	Both
–	<i>Lomandra fluviatilis</i>	ROTAP 3RCa	Both
steelhead	<i>Callitris monticola</i>	Regionally significant ROTAP 3RC-	Both
–	<i>Pultenaea</i> sp. J ('robusta')	Regionally significant	Flaggy Ck
–	<i>Hibbertia acuminata</i>	Regionally significant	Both
–	<i>Eriostemon myoporoides</i> ssp. <i>conduplica</i>	Regionally significant	Both

Source: NPWS Atlas of NSW Wildlife 2002, NPWS flora modelling database (NPWS 1999a), Briggs & Leigh 1995.

Note: Vulnerable and Endangered species are listed on the TSC Act. # Denotes species also listed on the EPBC Act. ROTAP codes: 2 = geographic range in Australia less than 100km; 3 = geographic range in Australia greater than 100km; V = vulnerable; R = rare; K = poorly known; C = at least one population reserved for conservation; a = 1000+ plants reserved for conservation; - = reserved population size unknown; t = total known population reserved.

NPWS is required by the TSC Act to prepare and implement recovery plans for all listed threatened plant and animal species. These are progressively being prepared and will be used to guide management of threatened species in the reserve.

Native animals

The vegetation communities of the Tallawudjah and Flaggy Creek Reserves provide a range of habitats for native fauna. Although no threatened fauna species have been recorded within the reserves, several are considered likely to occur, based on CRA modelling of suitable habitat (NPWS 1999) (refer to *Table 2*).

The reserves occupy part of a network of regional fauna movement corridors, which link the reserves to other forested land to the north, north-east and south-west (refer to *Native plants*) (NPWS 2001). Focal species for the corridors are the rufous bettong (*Aepyprymnus rufescens*), yellow-bellied glider (*Petaurus australis*) and brush-tailed phascogale (*Phascogale tapoatafa*). These corridors and the habitat contained within them provide for a range of priority fauna species in the moist escarpment-foothills and dry coastal foothills assemblages. These species are considered a priority for conservation because they are threatened, vulnerable to

threatening processes or largely endemic to the north-east NSW region (NPWS 2001). Species included within each of these assemblages are listed in *Appendix A (Tables A1 and A2)*.

Vegetated private lands surrounding the reserves are vital to the connectivity of fauna habitats in the region.

Table 2 Threatened fauna considered likely to occur within the reserves

Common name	Scientific name	Status*	Reserve
giant barred frog	<i>Mixophyes iteratus</i>	Endangered [#]	Both
green-thighed frog	<i>Litoria brevipalmata</i>	Vulnerable	Flaggy Ck
pale-headed snake	<i>Hoplocephalus bitorquatus</i>	Vulnerable	Tallawudjah
white-crowned snake	<i>Cacophis harriettae</i>	Vulnerable	Both
red-tailed black-cockatoo	<i>Calyptorhynchus banksii</i>	Vulnerable	Both
glossy black-cockatoo	<i>Calyptorhynchus lathami</i>	Vulnerable	Both
powerful owl	<i>Ninox strenua</i>	Vulnerable	Both
masked owl	<i>Tyto novaehollandiae</i>	Vulnerable	Both
hooded robin	<i>Melanodryas cucullata cucullata</i>	Vulnerable	Both
grey-crowned babbler	<i>Pomatostomus temporalis temporalis</i>	Vulnerable	Both
black bittern	<i>Ixobrychus flavicollis</i>	Vulnerable	Both
yellow-bellied glider	<i>Petaurus australis</i>	Vulnerable	Both
squirrel glider	<i>Petaurus norfolcensis</i>	Vulnerable	Both
brush-tailed phascogale	<i>Phascogale tapoatafa</i>	Vulnerable	Both
spotted-tailed quoll	<i>Dasyurus maculatus</i>	Vulnerable	Both
rufous bettong	<i>Aepyprymnus rufescens</i>	Vulnerable	Both
brush-tailed rock-wallaby	<i>Petrogale penicillata</i>	Vulnerable [#]	Tallawudjah
eastern cave bat	<i>Vespadelus troughtoni</i>	Vulnerable	Tallawudjah
large-footed myotis	<i>Myotis adversus</i>	Vulnerable	Both

Source: NPWS fauna modelling database (NPWS 1999a), NPWS Atlas of NSW Wildlife 2002.

Note: *Denotes status under the TSC Act. # Denotes species also listed under the EPBC Act.

Optimal habitat for priority fauna species, such as the *Emydura* sp. 1 and forest kingfisher (*Todiramphus macleayii*) also occur within the two reserves. Species such as the whiptail wallaby (*Macropus parryi*) and pale field-rat (*Rattus tunneyi*) may also occur within Tallawudjah Nature Reserve (NPWS 1999a).

No formal comprehensive flora and fauna surveys have been undertaken for either of the reserves.

Aboriginal cultural heritage

The land and water biodiversity values within a whole landscape context are the centre of Aboriginal spirituality and contribute to Aboriginal peoples identity. Aboriginal communities associate natural resources with the use and enjoyment of valued 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.

Tallawudjah and Flaggy Creek Nature Reserves fall within the boundaries of the Grafton-Ngerrie Local Aboriginal Land Council, and within the country of the Gumbaingirr Aboriginal people. The area also has significance for members of the Coffs Harbour Local Aboriginal Land Council.

No cultural heritage survey work has been undertaken in the reserves. Although no Aboriginal sites have been found within the reserves to date, numerous sites have been recorded within close proximity to both reserves. These sites include open camp sites, scarred trees, shelters with art, shelters with deposits and rock engravings. Several sites in the area are of national and regional importance. The Bull Paddock, a nationally significant site, is located approximately six kilometres to the north of the reserves within a bend in the Orara River. This site, together with the Middle Creek bora ground area, is thought to have been used by Aboriginal groups travelling between the Orara River and Blaxland Creek (ERM Mitchell McCotter 1999). These sites, together with historical and oral records, provide evidence of the use of the area by Aborigines.

Non-Aboriginal cultural heritage

Livestock grazing and timber production appear to be the dominant historical uses of lands surrounding Tallawudjah and Flaggy Creek Nature Reserves. Squatters, who were mainly cattle graziers, were the first recorded European people in the area of the reserves, occupying the Orara Valley from the 1840s. Early timber-cutting operations based on cedar, and subsequently hoop pine, began around the same time. The cutting of these timbers drew many men to the Coutts Crossing, Kangaroo Creek and Nymboida areas during the mid 1800s, with huge quantities of timber reputedly being cut following a decrease in supply closer to the Clarence River (Coutts Crossing and Nymboida Districts Historical Society 1988).

From the 1880s there was increased recognition of the value of North Coast hardwoods, and these forests were also logged for construction of bridges, wharves and railways. Small bush mills were built close to the timber source to reduce transport costs. These mills created small, specialised, isolated communities whose members worked on the site (Blackmore and Associates 1993). The timber industry in the area further expanded in the 1920s, following extension of the North Coast Railway and the introduction of logging trucks and crawler tractors to replace bullock teams (SFNSW 1995).

A disused sawmill site exists within Flaggy Creek Nature Reserve. This, together with the presence of stumps throughout the reserve, suggests previous use of the land for timber production. Little of the site remains except for a few upright posts in a clearing, perhaps part of an original building.

The western portion of Tallawudjah Nature Reserve was declared a Forestry Reserve from 1922 to 1974, with grazing leases being held over the land from 1962 onwards. Grazing leases over the rest of Tallawudjah Nature Reserve date back to the mid 1940s, although its grazing capacity was limited by the rough terrain.

Land along the eastern boundary of Flaggy Creek Nature Reserve was set aside in 1903 by the Rural Lands Protection Board (then known as the Pastures Protection Board) as part of a water and camping reserve and travelling stock route. The reserve was subject to grazing leases from the 1960s onwards.

No sites of historical significance are known to exist within either of the reserves. However a site of potential significance is the area known as "Sydney Heads," located immediately to the west of the north-western boundary of Tallawudjah Nature Reserve. This site consists of sandstone escarpments, named for their likeness to cliffs in the Sydney area, and is listed on the NPWS Historic Heritage Information Management System.

3.5 ACCESS AND VISITOR USE

Public access to Flaggy Creek Nature Reserve is at the eastern border of the reserve via the Orara Way (see *Map 1*). Other trails to the south and west of the reserve are within private property and are not accessible to the public, or to the NPWS without permission. Management trails within the reserve will be closed to public vehicle use, with access permitted only by foot.

The relatively small size of Flaggy Creek Nature Reserve has implications for its suitability for public use. Non-nature based recreational activities within this reserve would be concentrated within a small area, which may result in an unacceptable level of impact on native vegetation and soils.

Tallawudjah Nature Reserve is completely surrounded by private property, and public access to the reserve is not currently available (see *Map 2*). Ongoing access to this reserve by the NPWS requires negotiation with surrounding property owners.

Signage identifying the location of Flaggy Creek Nature Reserve exists along the Orara Way, at the southern and northern boundaries. No signage exists within Tallawudjah Nature Reserve. There are no recreation facilities in the reserves.

The reserves currently receive low levels of use for low-impact, self-sufficient, nature based recreation, such as bird watching and bushwalking. The reserves have been utilised for recreational four-wheel-driving in recent years. Recreational activities not consistent with the study of nature and natural environments are generally considered inappropriate uses of a nature reserve. Activities such as horse riding, recreational trail bike riding or four-wheel driving and camping are generally considered inconsistent with the purposes of a nature reserve under the NPW Act. Recreational four-wheel driving and horse riding are also inappropriate in areas containing the highly erodible soils found within the reserves.

National parks in the region, such as Chaelundi and Nymboi-Binderay National Parks to the west and south-west of the reserves, provide for a complementary range of recreational activities such as camping, picnicking, canoeing, fishing, bird watching, bushwalking and four-wheel driving. Visitor facilities and opportunities for car touring, four-wheel driving, picnicking, cycling and the enjoyment of scenic sites, also exist in nearby State Forest areas (NPWS and SFNSW 2001).

3.6 OTHER RESERVE USES

Two licensed apiary sites are located within Flaggy Creek Nature Reserve and are recognised as an 'existing interest' under the NPW Act (see *Map 1*). The existing apiary sites are limited in size and are maintained by mowing or slashing. Access to the sites is via management trails within the reserve.

Underground Optus cables traverse the north-east corner Flaggy Creek Nature Reserve, where it abuts the Orara Way (see *Map 1*). These also predate gazettal of the reserve. No formal easements are in place for underground cables within the reserves.

Two overhead TransGrid transmission lines traverse the reserves (see *Maps 1 and 2*). The first is a 330kV line (89 Armidale to Lismore line) traversing the north-east corner of Tallawudjah Nature Reserve. The second is a 132kV line (the 96H Coffs Harbour to Grafton line), which passes through sections of Flaggy Creek Nature Reserve, along the northern and eastern boundaries. No structures associated with these lines are known to exist within the reserves. These transmission lines predate gazettal of the reserves, however, no formal easements for these structures have been granted under the NPW Act to date.

Access to the power line and underground cables within Flaggy Creek Nature Reserve is via the Orara Way or adjacent private property. The line traversing Tallawudjah Nature Reserve is accessed via private roads and cleared areas beneath the line. Both of the powerlines were constructed and operational prior to the gazettal of the reserves.

Transmission lines and associated developments generate impacts such as clearing or trimming of vegetation, use of herbicides and the maintenance of access trails, as well as the visual impact of the lines. A state-wide agreement between TransGrid and the NPWS for inspection and maintenance of existing transmission lines and infrastructure was implemented in October 2002.

3.7 MANAGEMENT OPERATIONS

Tallawudjah Nature Reserve is surrounded by private property and is inaccessible to the public (refer to Section 3.5; see *Map 2*). Access to the reserve by the NPWS for management purposes is via private roads and on foot, with permission from adjacent property owners. No formal or long-term access arrangements are in place at present. Options for ongoing access to the reserve need to be investigated as a priority.

Vehicle access to the reserves will be limited to that required for management purposes only, due to the potential for disturbance to sandy soils and threatened plants (refer to Section 3.5). Management trails within Flaggy Creek Nature Reserve will be maintained to a four-wheel-drive dry weather standard and gated to exclude public vehicle use (see *Map 1*). Public access by foot will be permitted on all trails.

Part of the Western Boundary Trail within Flaggy Creek Nature Reserve is steep and prone to erosion. The northern section of this trail is blocked in two places by boundary fencing, and does not provide adequate access to the western and northern boundaries for management purposes, in particular fire management and/or suppression. Due to its current condition, the trail is only suitable for northbound (downslope) vehicle use. This section requires works to reduce soil loss, prevent sedimentation of Flaggy Creek and ensure safe vehicle access for management purposes (refer to Section 3.8 *Soil erosion* and Section 4 *Soils and hydrology*).

To re-route the trail within the reserve to avoid the boundary fence would require the clearance of additional native vegetation. The presence of a large rock shelf within the reserve to the east of the current trail is also a major constraint to this option. It is considered that a more suitable option would be to install gates along the boundary fence to enable the use of the trail in its current location. Agreement with the adjacent property owner will be sought to allow safe, adequate and ongoing access.

Boundary fencing is inadequate or absent in parts of the reserves and in some areas reserve boundaries are unmarked or unclear. This uncertainty may result in the use of reserved lands for inappropriate activities (refer to Section 3.8 *Native vegetation clearance*) and confusion regarding the location of non-NPWS infrastructure in relation to reserve boundaries (refer to Section 3.6 *Other Reserve Uses*). Inadequate fencing may also result in livestock from adjacent lands straying into the nature reserves (refer to Section 3.8 *Introduced plants and animals*) or unauthorised vehicle use (refer to Section 3.5). The boundaries of the reserves need to be identified and marked to correctly identify their location in the field.

3.8 THREATS TO RESERVE VALUES

Fire

Fire is a natural feature of the environment of the reserves and is essential to the survival of some plant communities. It is one of the continuing physical factors influencing the Australian environment. However, inappropriate fire regimes have been identified as a key threatening process affecting the biological diversity of NSW as frequent fire can cause loss of particular plant and animal species and communities. Fire could also damage cultural features, fences and threaten neighbouring land.

Most of Tallawudjah Nature Reserve and the whole of Flaggy Creek Nature Reserve were burnt by wildfire in August 2002. Prior to this fire, the reserves remained mostly unburnt for about eight years, but records appear incomplete.

Fires in the reserves are typically due to escaped hazard reduction or other agricultural burns on neighbouring lands, which are generally situated down slope from the reserves. Due to their position in the landscape and the lack of vehicular access to much of the area, most fires move onto the reserves from adjoining property, rather than starting within the reserves.

Aside from fences, there are few assets immediately surrounding the reserves that may be threatened by fire. As such, fires within the reserves generally pose a low risk to neighbouring assets and no particular fire management strategies are required to protect life and property. There are, however, some buildings and other improvements more distant on neighbouring lands.

From observation, fire frequencies over much of the area are excessive for the maintenance of biodiversity. Fire is considered to be a threat to the hairy melichrus, as adult plants do not appear to re-sprout after fire. The intensity of fire required for germination of the seed is unknown. Too frequent fire may also be a threat to the successful regeneration of other threatened plants within the reserves, including the sandstone rough-barked apple, square-fruited ironbark, Moonee quassia, *Triplarina imbricata* and *Lindsaea incisa* (NPWS 2002b). Fire must be managed to promote regeneration and conservation of these and other significant flora species within the reserves.

Firebreaks have been cleared along the northern boundary and parts of the western and southern boundaries of Flaggy Creek Nature Reserve. The southern boundary of the reserve is relatively exposed to the threat of fire from private property. Private roads through neighbouring land to the south and south-west of the reserve, however, offer a degree of protection against fire from this direction. The Orara Way provides fire protection for properties to the east of the reserve. Management trails running east-west within the reserve (see *Map 1*) may also assist in containing the northward and southward movement of fires.

Due to the limited access and rugged topography of the reserve, no fire management trails or firebreaks presently exist within Tallawudjah Nature Reserve. A recently constructed trail near the eastern boundary of the reserve may be used for fire and other management purposes, depending on future access arrangements.

The NPWS is a fire authority under the *Rural Fires Act 1997*. Management of NPWS estate is in accordance with an adopted state-wide NPWS strategy for fire management planning (NPWS 2002c), with the following objectives:

- To reduce the occurrence of human-caused unplanned fires in NPWS estate.
- To suppress unplanned fires occurring in NPWS estate.
- To minimise the potential for spread of bushfires on, from or into NPWS estate.
- To protect from bushfire occurring in NPWS estate, persons and property on, or immediately adjacent to, NPWS estate.
- To manage bushfires to avoid the extinction of all species which are known to occur naturally within NPWS estate.

- To protect from damage by bushfires all Aboriginal sites, historic places and culturally significant features which are known to exist in NPWS estate.

NPWS regards cooperative fire management as essential for the protection of life and surrounding property, as well as for protection of the natural and cultural heritage of the reserve. NPWS maintains cooperative arrangements with surrounding landowners and RFS brigades and is actively involved in the Clarence Valley Bush Fire Management Committee. Cooperative arrangements include approaches to fuel management, support for neighbours' fire management efforts, information sharing and preparation of district bushfire management plans for the area covered by this committee.

A review of fire management by NPWS has resulted in a modified approach based on the level of complexity involved. In regard to Flaggy Creek and Tallawudjah Nature Reserves, the NPWS considers that it is appropriate to include the specific fire management strategies for the reserve in this plan of management.

The NPWS approach to fire management planning (2002c) uses a system of zones that are compatible with district bushfire risk management plans. These zones are management areas where a specified fire management operational objective, strategy and performance indicator have been developed to mitigate against the threat of a wildfire.

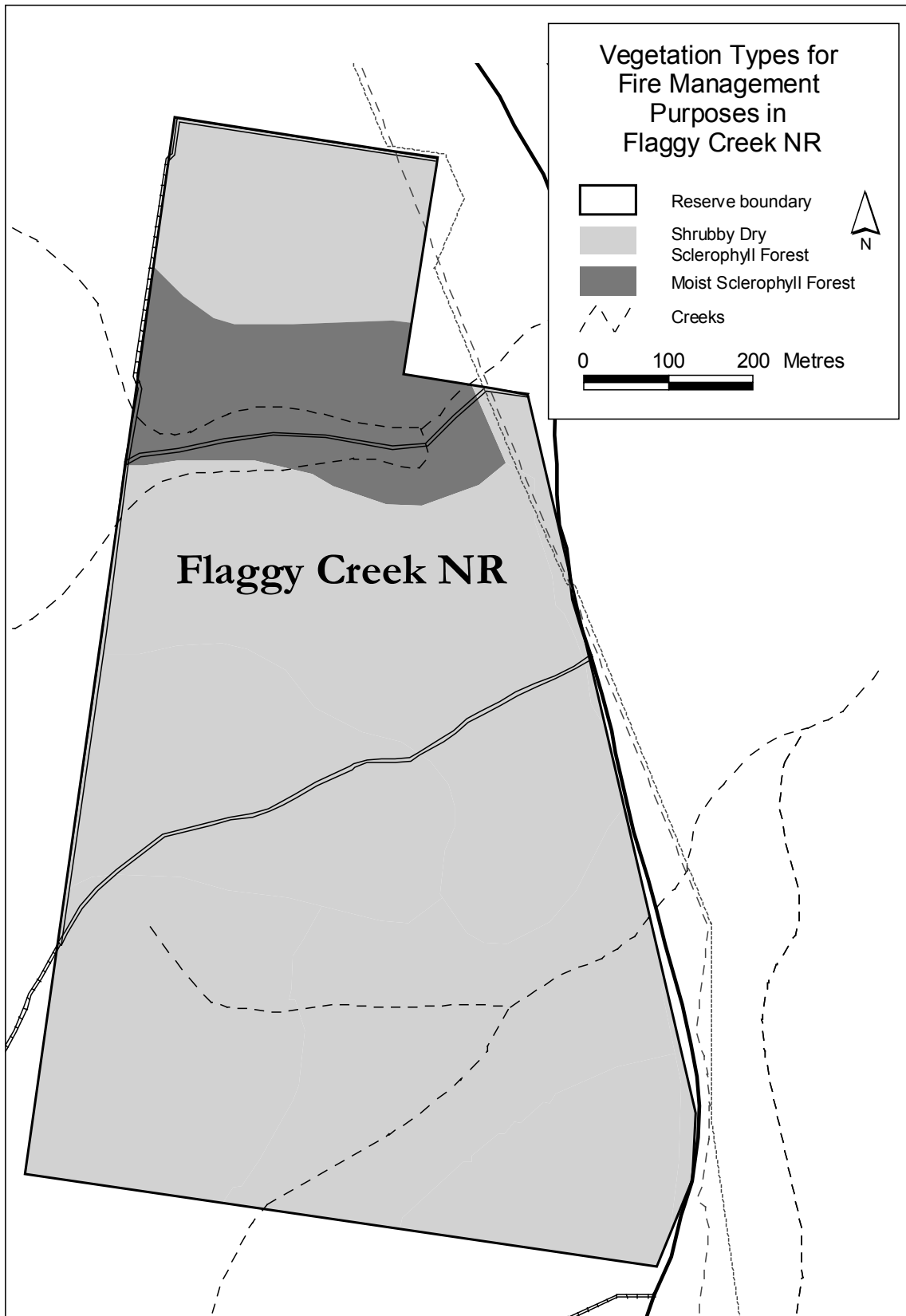
The entire area of Flaggy Creek and Tallawudjah Nature Reserves has been classified as Heritage Area Management Zones (HAMZ) because fire intervals in both reserves have been too short to maintain desired biodiversity thresholds. The primary fire management objectives within the zone are to prevent the extinction of all species which are known to occur naturally within the reserves, and to protect culturally significant sites within the reserves including Aboriginal and non-Aboriginal sites.

Ecological research in fire-prone ecosystems has established some general principles about fire regimes and the conservation of biodiversity. That is, groups of plants and animals respond similarly to fire according to characteristics of their life history. Therefore it is not necessary to individually specify fire regimes for the conservation of every species. Requirements for most plant species can be summarised on the basis of vegetation communities and there is a threshold in fire regime variability that marks a critical change from high species diversity to low species diversity. The following fire regime guidelines have been identified for Flaggy Creek and Tallawudjah Nature Reserves, based on the vegetation classes shown on Maps 3 and 4 (pages 17 and 18).

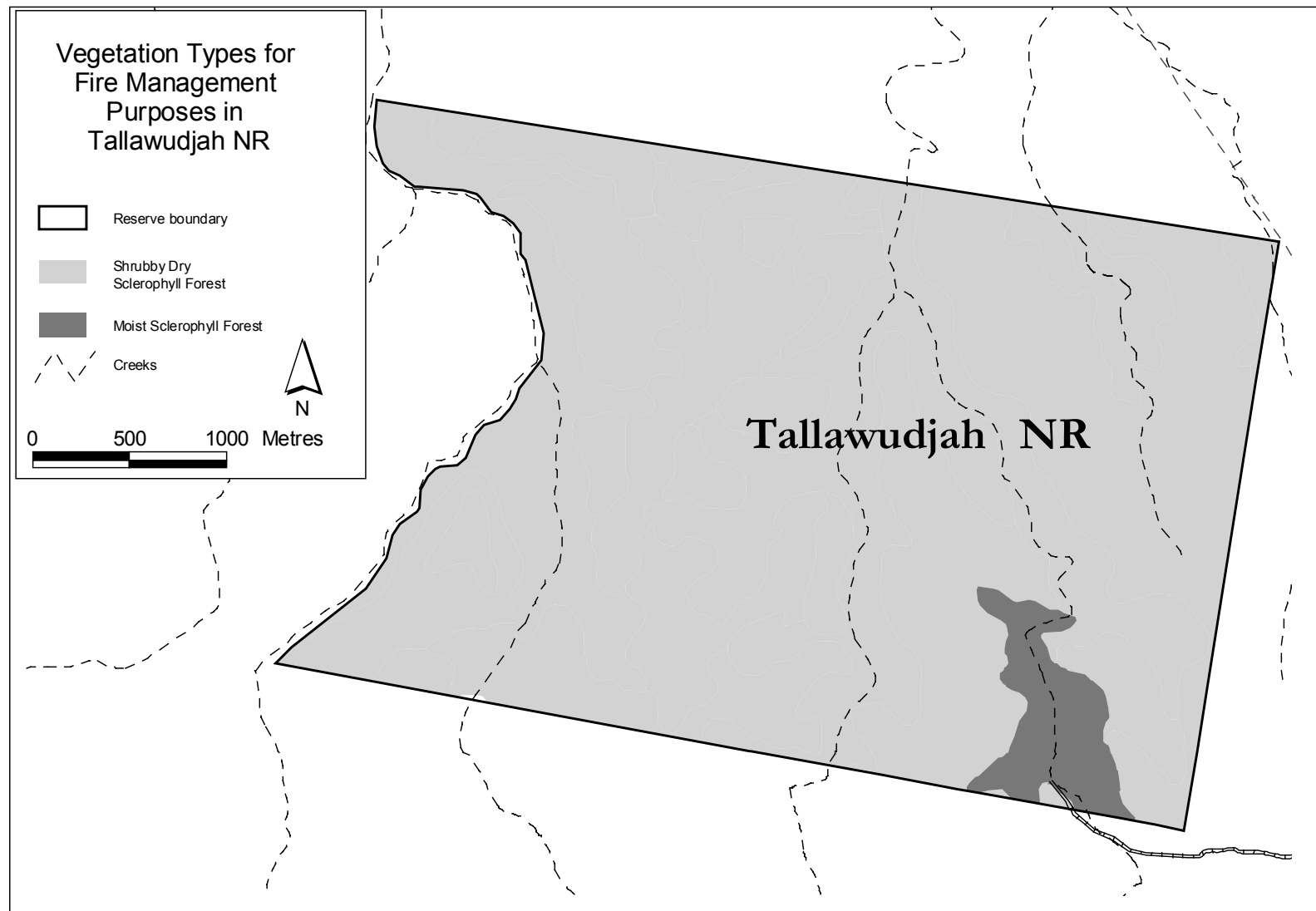
Table 3 Fire Regime Guidelines for Flaggy Creek and Tallawudjah Nature Reserves.

Vegetation type	Minimum interval	Maximum interval	Notes
Shrubby Dry Sclerophyll Forest	7	30	
Moist Sclerophyll Forest	25	60	Crown fires should be avoided at the lower end of the interval range.

Source: NPWS intranet, based on Auld & O'Connell (1991), Keith (2002), Keith et al (2002), Morrison et al (1995)."



Map 3: Flaggy Creek Nature Reserve Vegetation



Map 4: Tallawudjah Nature Reserve Vegetation

Based on these fire regime guidelines, fire should be avoided for a minimum of 7 years from each fire occurrence for the majority of the reserves, or 25 years in wetter vegetation types (see Maps 3 and 4).

Introduced plants and animals

Several weed species have been recorded within Tallawudjah Nature Reserve, including groundsel bush (*Baccharis halimifolia*), lantana (*Lantana camara*), woody weeds and exotic vines and grasses. Lantana, camphor laurel (*Cinnamomum camphora*), exotic grasses and herbaceous weeds are known to occur within Flaggy Creek Nature Reserve (NPWS 2002a, Scanlon 2001). Weed species are thought to pose a minor problem within the two reserves.

Feral goats (*Capra hircus*) have recently been observed within Flaggy Creek Nature Reserve. No pest species have been recorded within Tallawudjah Nature Reserve, although wild dogs (*Canis familiaris*) are thought to occur in this area. Red foxes (*Vulpes vulpes*), wild dogs and feral cats (*Felis catus*) have been recorded in Sherwood Nature Reserve to the east. Foxes and dogs have also been recorded within Koukandowie Nature Reserve to the north-west (NPWS 2002a). It is possible that these species may also occur within Tallawudjah and Flaggy Creek Nature Reserves. Foxes in particular are likely to occur within Flaggy Creek Nature Reserve, as this species is commonly found in areas with an urban/rural interface (NPWS 2002a). Predation by these species may impact on the population sizes of a range of native wildlife, including mammals, ground nesting birds and reptiles.

Livestock and domestic animals from adjacent lands may occasionally stray into parts of the reserves where fencing is inadequate or absent. Although not bound by legislation to provide for fencing of NPWS estate, the NPWS recognises that cooperative boundary fencing may enhance conservation values and resolve management problems within reserves. NPWS policy on boundary fencing covers fencing adjacent to private property, leasehold and Crown lands.

Managed honeybees may occasionally be present within Flaggy Creek Nature Reserve, under a licence issued for the use of two apiary sites within the reserve (refer to section 3.6). Beekeeping within Flaggy Creek Nature Reserve is considered to pose a low risk to biodiversity due to limitations on the size and number of sites, combined with very low usage of the sites within the reserve. In contrast, competition from feral honey bees for tree hollows, nectar and pollen has been identified as a key threatening process under the *Threatened Species Conservation Act 1995*. Feral bees usually originate from sources other than hives on apiary sites (Paton 1996). If feral bees become established they may be a risk to biodiversity. No feral hives are known to currently exist within the reserves.

Native vegetation clearance

Clearance or disturbance of vegetation within the reserves is not permitted unless carried out for NPWS management purposes, in accordance with this plan of management.

The reserve boundaries are unclear in some areas (refer to Section 3.7), particularly where boundary fencing is absent. Reserve boundaries need to be identified and marked to prevent the unintentional occurrence of inappropriate activities within the reserves.

Soil erosion

Soils in the reserves are prone to a range of erosion hazard levels. The majority of the reserves have a moderate to high potential hazard for topsoil and subsoil erosion, with high to extreme erodibility predicted for steeper parts of Tallawudjah Nature Reserve (refer to *Appendix B, Table B1*).

A section of the western management trail within Flaggy Creek Nature Reserve has undergone extensive erosion, south of Flaggy Creek (see *Map 1*). This rocky section is prone to soil movement, particularly after rainfall. In its current state, this section of the trail can only be used for access in a northerly direction, as it is too dangerous to climb the section from the north. Further assessment of this section of the trail is required to determine the most appropriate method of restoring the trail for ongoing access for management purposes.

4. FLAGGY CREEK AND TALLAWUDJAH NATURE RESERVES—MANAGEMENT ISSUES AND STRATEGIES

Current Situation	Desired Outcomes	Actions and Guidelines	Priority
<p>Soils and hydrology</p> <p>Steep slopes and highly erosive soils occur throughout both reserves.</p> <p>Disturbed areas and exposed soils exist within Flaggy Creek Nature Reserve, including a disused sawmill site, gravel pits and mounds and a dam. Some of these areas have impacted on natural drainage patterns.</p> <p>A section of the Western Boundary trail within Flaggy Creek Nature Reserve is prone to erosion and requires works to reduce soil loss, prevent sedimentation of nearby Flaggy Creek and ensure safe management access.</p>	<ul style="list-style-type: none"> • There is no evidence of increased soil erosion from reserve management activities and visitor use. • There is no reduction in the water quality and health of watercourses in the reserves. • Natural flow regimes are restored in disturbed areas. • No further damage to management trails results from public vehicular use. 	<ul style="list-style-type: none"> • Undertake all works, such as trail maintenance and hazard reduction burning, in a manner that minimises soil erosion and water pollution. • Undertake drainage works in disturbed areas to restore natural drainage flows. This may include filling dams and gravel pits and removing gravel mounds. • Encourage the natural regeneration of native vegetation in disturbed areas to reduce erosion potential and sedimentation of streams. Supplement natural regeneration with weed control, site preparation and rehabilitation programs, using native plants from local genetic stock, where necessary. • Following an assessment of appropriate options, undertake works to restore and stabilise the eroding section of Western Boundary Trail within Flaggy Creek Nature Reserve. • Management trails (see <i>Map 1</i>) will not be available for public vehicular use and will be gated or signposted accordingly. 	<p>Ongoing</p> <p>Medium</p> <p>Medium</p> <p>High</p> <p>High</p>

Current Situation	Desired Outcomes	Actions and Guidelines	Priority
<p>Native plants and animals</p> <p>Two threatened plant species are known to occur in the reserves and several threatened flora and fauna species are likely to occur. Further surveys are required to identify significant species and/or communities within the reserves.</p> <p>The endangered hairy melichrus often occurs in disturbed areas within the reserves, such as along trails and fencelines. This species is considered sensitive to fire and may be affected by management activities or visitor use.</p> <p>Old growth forests occupying much of the planning area are of high conservation value and are sensitive to fire.</p> <p>Vegetated areas on adjacent private land are important in providing connectivity between vegetation communities and habitats.</p> <p>Illegal logging may be a threat to forested areas of the reserves (refer to Section 3.8).</p>	<ul style="list-style-type: none"> • There is no reduction in the diversity of native plants, animals or populations in the reserves, particularly significant species. • There is an increased understanding and knowledge of the ecological needs and characteristics of plants and animals in the reserves. • Conservation and corridor values of the reserves are enhanced by retention of vegetated areas on adjacent private land. • Cleared and disturbed areas in the reserves that are not required for management purposes are rehabilitated. 	<ul style="list-style-type: none"> • Undertake or encourage a formal flora and fauna survey and other appropriate research that increases knowledge of native plants and animals within the reserves, their populations, distribution and ecological needs (refer to <i>Fire management and Research</i>). • Work with neighbours, local Landcare groups and vegetation management committees to promote, support and encourage the protection of high conservation value vegetation adjacent to the reserves through appropriate conservation mechanisms, particularly in those areas identified as forming corridors or containing key habitat for fauna (NPWS 2001). • Promote the natural regeneration of native vegetation in disturbed areas not required for management purposes, such as the disused sawmill site and gravel pits or emergency firebreaks within Flaggy Creek Nature Reserve (refer to <i>Soils and hydrology</i>). • Undertake a boundary survey of the reserves to confirm correct boundary lines. Notify neighbours of the surveyed boundary location to reduce the potential for unintentional logging, or other inappropriate activities, to occur within the reserves (refer to <i>Management operations and Introduced plants and animals</i>). • Carry out management activities so as to avoid disturbance to threatened and significant plant species. In particular, avoid disturbance to the hairy melichrus during trail and fence maintenance works. 	<p>High</p> <p>Ongoing</p> <p>Medium</p> <p>High</p> <p>Ongoing</p>

Current Situation	Desired Outcomes	Actions and Guidelines	Priority
<p>Cultural heritage</p> <p>No formal, comprehensive surveys have been undertaken within the reserves for sites of Aboriginal or non-indigenous cultural significance.</p> <p>No Aboriginal or non-Indigenous cultural sites have been recorded within the reserves. Several Aboriginal cultural sites and one historic site have been recorded on surrounding lands.</p>	<ul style="list-style-type: none"> • Cultural heritage features and values are not diminished and are identified, conserved and managed in accordance with their significance. • Aboriginal heritage values are protected in partnership with the local Aboriginal community. 	<ul style="list-style-type: none"> • Work with the local Aboriginal community, relevant Local Aboriginal Land Councils and knowledge holders to identify and manage Aboriginal cultural heritage sites, places and values. • Undertake or encourage appropriate Aboriginal cultural heritage survey within the planning area (refer to <i>Research</i>). • Encourage appropriate research into non-Indigenous cultural heritage values in the planning area (refer to <i>Research</i>). 	<p>High</p> <p>High</p> <p>Medium</p>

Current Situation	Desired Outcomes	Actions and Guidelines	Priority
<p>Introduced plants and animals</p> <p>A targeted survey has been undertaken for pest species within the reserves.</p> <p>Pest plant species recorded include lantana, groundsel bush, woody and herbaceous weeds and exotic vines and grasses. Feral goats exist, and honeybees (refer to <i>Other reserve uses</i>) may sometimes be present, within Flaggy Creek Nature Reserve. Foxes, cats and wild dogs may also be present in both reserves.</p> <p>A draft Pest Management Strategy (NPWS 2002a) has been developed for the region as a whole. This strategy identifies pest populations, priorities for control and outlines suggested control methods.</p> <p>Appropriate fencing is important to minimise the likelihood of domestic stock entering the reserves.</p>	<ul style="list-style-type: none"> • Pest species are controlled and, where possible, eradicated. • The impact of introduced species on native species, reserve values and neighbouring lands is minimised. • The distribution of lantana, groundsel bush and other weed species does not expand beyond the current extent. • Control of introduced species has minimal impact on native species. 	<ul style="list-style-type: none"> • Monitor, control and, where possible, eradicate introduced pest plant and animal species found in the reserves, in accordance with the Regional Pest Management Strategy. Control of feral goats will be a priority. • Seek the cooperation of neighbours, the Grafton Rural Lands Protection Board, Pristine Waters Shire Council, the Clarence Valley Weeds Authority and other stakeholders in implementing pest plant and animal control programs. • Encourage appropriate research into the distribution and impacts of pest species within the reserves and appropriate control measures (refer to <i>Research</i>). • Where necessary, negotiate fencing agreements with neighbours to exclude livestock from the reserves in accordance with the NPWS Boundary Fencing Policy. 	<p>Medium</p> <p>Ongoing</p> <p>Medium</p> <p>High</p>

Current Situation	Desired Outcomes	Actions and Guidelines	Priority
<p>Fire management</p> <p>The reserves appear to be burnt too frequently for the maintenance of biodiversity, with the most recent wildfire occurring in August 2002. This fire extended over a large portion of the reserves.</p> <p>Fire is considered to be a threat to a number of significant plant species and could also damage cultural features, signage and fences.</p> <p>Fires within the reserves are unlikely to threaten neighbouring land. Fires originating from neighbouring lands may affect the reserves, if not adequately contained.</p> <p>Firebreaks exist along most boundaries of Flaggy Creek Nature Reserve. Additional fire protection for the southern boundary may be required. Existing roads and trails offer some degree of fire protection for the reserve and adjacent properties.</p>	<ul style="list-style-type: none"> • Life, property and natural and cultural values in and adjacent to the reserves are protected from bushfire. • Fire regimes are appropriate for the conservation and enhancement of native flora and fauna communities. • The potential for spread of bushfires on, from, or into the park is reduced. • Neighbours and nearby communities appreciate the requirement for, and cooperate in applying, fire management objectives and prescriptions for the reserves. 	<ul style="list-style-type: none"> • Manage the reserves as Heritage Area Management Zones to suppress unplanned fires and, where possible, exclude fire from fire-sensitive communities and populations, cultural features and recently burnt areas. • Continue to participate in the Clarence Valley Zone Bush Fire Management Committee. Maintain coordinated and cooperative arrangements with Rural Fire Service Brigades, Pristine Waters Council and neighbours with regard to fuel management and fire suppression. • Work with neighbours to support their efforts to contain fire on their own properties, protect their own assets and report unplanned ignitions. Provide information and advice to neighbours regarding the ecological impact of fire and fire management issues. • Investigate the potential for providing additional fire protection along the southern boundary of Flaggy Creek Nature Reserve, having regard to potential environmental and safety issues. Options may include the creation of a firebreak. • Before the start of each fire season, prepare Fire Suppression Guideline maps for the reserves, detailing all information relevant to fuel and fire incident management within the reserves, including fire/management trails and other advantages, natural and cultural assets at risk and areas proposed for prescribed burns. 	<p>High</p> <p>Ongoing</p> <p>High</p> <p>High</p> <p>Ongoing</p>

Current Situation	Desired Outcomes	Actions and Guidelines	Priority
<p>No fire management trails or firebreaks exist within Tallawudjah Nature Reserve. A trail created near the eastern boundary may be used for management purposes.</p>		<ul style="list-style-type: none"> • Monitor the impacts of fire on species and ecosystems within the reserves and encourage appropriate research, such as impacts of fire regimes on soil seed banks and on threatened flora species, particularly <i>melichrus hirsutus</i> (refer to <i>Native plants and animals and Research</i>). • Investigate the potential for improving fire protection in Tallawudjah Nature Reserve, having regard to fire history in the reserve, as well as potential environmental and safety issues. Options could include the creation of firebreaks and/or trails within the reserve for management purposes. Where clearance of emergency firebreaks or trails within the reserves occurs, affected areas are to be rehabilitated following use if required (refer to <i>Soils and hydrology, Management operations and Native plants and animals</i>). 	<p>Ongoing</p> <p>High</p>

Current Situation	Desired Outcomes	Actions and Guidelines	Priority
<p>Access and visitor use</p> <p>Access to Flaggy Creek Nature Reserve is via the Orara Way. Tallawudjah Nature Reserve is not accessible to the public.</p> <p>The reserves experience a low level of recreational use. There are no recreational facilities or interpretive signs within the reserves.</p> <p>Public vehicle use is considered inappropriate within both reserves, due to the high potential for soil erosion and potential disturbance to threatened plants.</p> <p>Activities such as horse riding, trail bike riding and four-wheel driving have the potential to impact upon reserve values and conflict with other users.</p> <p>Promotion of community understanding and appreciation of the conservation values of the reserves will be important in achieving conservation objectives and minimising damaging activities.</p>	<ul style="list-style-type: none"> • Visitor use is low key, self-reliant and ecologically sustainable, in accordance with management principles (refer to Section 1.2). • The local community and visitors understand the values of the reserves and support management programs. • Educational opportunities are provided, consistent with reserve values and dependant on reserve access opportunities. 	<ul style="list-style-type: none"> • Rationalise access to Flaggy Creek Nature Reserve from the Orara Way to provide more appropriate access for management purposes (see <i>Map 1</i>, refer to <i>Management operations</i>). Relocating the entrance will further exclude public vehicles. • Promote community understanding and appreciation of the conservation values of Flaggy Creek Nature Reserve by providing interpretive and minimal impact use information at the southern reserve entrance, off the Orara Way. In particular, provide information on the role of nature reserves, threatened species occurring within the reserve, their management requirements and potential threats. • Include information on the reserves in educational and recreational material/brochures for protected areas within the region, to promote community understanding and appreciation of reserve values. • Provide signage for Flaggy Creek Nature Reserve at the entrance to Sawmill Trail, off the Orara Way. Retain the signage at the northern and southern boundaries of the reserve, adjacent to the Orara Way. • Fence or otherwise secure the eastern boundary of Flaggy Creek Nature Reserve, including the existing entrance to Flaggy Creek Trail, to prevent the unauthorised entry of vehicles into the reserve and associated disturbance to soils and native vegetation (refer to <i>Management operations</i>). 	<p>Medium</p> <p>Low</p> <p>Medium</p> <p>High</p> <p>High</p>

Current Situation	Desired Outcomes	Actions and Guidelines	Priority
		<ul style="list-style-type: none"> • Camping, horse riding, trail bike riding and recreational 4-wheel-driving will not be permitted within the reserves. • Monitor visitation levels and impacts of visitor use. Undertake measures to reduce impacts where they are found to be unacceptable. 	<p>Ongoing</p> <p>Ongoing</p>
<p>Research</p> <p>Further research is needed to improve understanding of the reserves' natural and cultural heritage, the processes that affect them and the requirements for management of particular species, sites or areas.</p>	<ul style="list-style-type: none"> • Research that enhances the management information base and has minimal environmental impact. 	<ul style="list-style-type: none"> • Undertake and encourage appropriate research to improve knowledge and management of natural and cultural heritage, as identified within this plan (refer to <i>Native plants and animals, Introduced plants and animals, Cultural heritage</i> and <i>Fire management</i>). 	<p>High</p>

Current Situation	Desired Outcomes	Actions and Guidelines	Priority
<p>Other reserve uses</p> <p>Aboveground transmission lines traverse both of the reserves. The transmission lines predate gazettal of the reserves, however, easements have not been formally granted under the NPW Act.</p> <p>Underground communication cables exist within Flaggy Creek Nature Reserve. No formal easements are in place for underground cables within the reserves.</p> <p>Two licensed apiary sites exist within Flaggy Creek Nature Reserve.</p>	<ul style="list-style-type: none"> • All existing non-NPWS infrastructure is formally licensed or granted an easement consistent with the NPW Act. • Any further non-NPWS infrastructure developed within the reserves is for purposes consistent with the NPW Act. • Existing non-park infrastructure is managed to minimise impacts on natural and cultural values, scenic values and park infrastructure. • Apiary sites are licensed and managed in accordance with NPWS policy, and do not seriously compromise reserve values or reserve management activities. 	<ul style="list-style-type: none"> • Any proposed non-NPWS infrastructure within the reserves will not be permitted unless the development is for purposes consistent with the NPW Act. • NPWS will undertake negotiations to grant licences, leases or easements for existing developments, or any developments that may be required and approved in the future, under the provisions of the NPW Act and seek proper commercial returns for non-NPWS uses where appropriate. • Manage existing powerlines in accordance with the agreement with TransGrid, the NPW Act and NPWS policy. • Continue to manage existing apiary sites in accordance with NPWS policy. • Develop an agreement with apiarists for management and maintenance of access tracks to their apiary sites, with consideration given to threatened species and soil management issues. This may include requirement of a financial contribution from apiarists for maintenance of tracks required primarily for apiary site access. • Develop reserve-specific maintenance and access agreements with relevant power and communications companies/authorities, if required. This may include conditions regarding vegetation and fauna management, including consideration of any recommendations from threatened species recovery plans. 	<p>High</p> <p>Low</p> <p>Ongoing</p> <p>Ongoing</p> <p>Ongoing</p> <p>Medium</p>

Current Situation	Desired Outcomes	Actions and Guidelines	Priority
<p>Management operations</p> <p>The Western Boundary Trail within Flaggy Creek Nature Reserve is steep and prone to erosion in one section. This trail is currently only suitable for northbound vehicle use (refer to Section 3.8 <i>Soil erosion</i>).</p> <p>The northern section of this trail is blocked by boundary fencing, and does not currently provide adequate access for management purposes.</p> <p>Management trails within Flaggy Creek Nature Reserve are currently accessible to public vehicles (refer to Section 3.5).</p> <p>Some boundary fencing is inadequate for management purposes and the correct boundaries of the reserves are unclear in places (refer to Sections 3.5, 3.7 and 3.8 <i>Introduced plants and animals</i>). One fenceline within Flaggy Creek Nature Reserve has fallen into disrepair and is not required for management purposes.</p>	<ul style="list-style-type: none"> • Management trails adequately serve management needs and have an acceptable impact on the natural and cultural values of the reserves. • Management trails are maintained to an appropriate standard for use by the NPWS and fire authorities. • Boundary fences are maintained to prevent incursions from livestock and public vehicle access. Fences in disrepair that are not required for management purposes are removed. • The reserve boundaries are clearly defined to minimise the occurrence of activities that may affect the natural and cultural values of the reserves. 	<ul style="list-style-type: none"> • Undertake maintenance works on management trails as necessary to allow adequate access for management purposes (refer to <i>Fire management</i> and <i>Soils and hydrology</i>). • Gate management trails to exclude public vehicles (refer to <i>Access and visitor use</i>, <i>Soils and hydrology</i> and <i>Native plants and animals</i>). Install locks on gates to allow access by fire authorities and authorised line maintenance personnel (refer to <i>Fire management</i> and <i>Other reserve uses</i>). • Rationalise the eastern entrance to Flaggy Creek Trail, within Flaggy Creek Nature Reserve, to provide more appropriate access for management purposes (see <i>Map 1</i>; refer to <i>Access and visitor use</i>). This may include closing the existing access from Orara Way to Flaggy Creek Trail and installing an alternate locked gate on the adjacent east-west boundary, making vehicle access through private property. • Install two gates along the western boundary of Flaggy Creek Nature Reserve, north of Flaggy Creek, where the management trail is blocked by boundary fencing. • Remove unnecessary and decayed section of fenceline within Flaggy Creek Nature Reserve. • Undertake a boundary survey of the reserves to confirm correct boundary lines and notify neighbours. 	<p>Ongoing</p> <p>High</p> <p>Medium</p> <p>High</p> <p>High</p> <p>High</p>

Current Situation	Desired Outcomes	Actions and Guidelines	Priority
Ongoing access to Tallawudjah Nature Reserve by the NPWS requires negotiation with surrounding property owners (refer to Sections 3.5 and 3.7).		<ul style="list-style-type: none"> Negotiate and formalise a management access agreement with relevant neighbours to Tallawudjah Nature Reserve. 	High

Legend for priorities

High priority actions are those that are imperative to the achievement of management objectives identified in this Plan and need to be implemented in the near future to prevent degradation of the natural and cultural values or physical resources of the reserves, significant costs associated with rehabilitation at a later date, and/ or unacceptable risk to the public.

Medium priority actions are those that are necessary to achieve management objectives but will be implemented as resources become available because the time frame for their implementation is not urgent.

Low priority actions are desirable to achieve management objectives but can wait until resources become available.

REFERENCES

- Auld, T.D. & O'Connell, M.A. 1991. 'Predicting patterns of post-fire germination in 35 eastern Australian Fabaceae'. *Australian Journal of Ecology* **16**, 53-70.
- Blackmore and Associates. 1993. *Grafton Management Area EIS Supporting Document No. 4 - European Heritage: Historical Report*. State Forests of NSW.
- Briggs, J.D. and Leigh, J.H., 1995. *Rare or Threatened Australian Plants* (Revised Edition). CSIRO Publishing, Collingwood, Victoria.
- Coutts Crossing and Nymboida Districts Historical Society. 1988. *A history of Coutts Crossing and Nymboida Districts: Volume Two*. Clarence Press, Maclean.
- ERM Mitchell McCotter Pty Ltd. 1999. *Regional Water Supply Project Environmental Impact Statement Volume 1*. Lower Clarence County Council.
- Forestry Commission of NSW. 1984. *Management Plan for Coffs Harbour Management Area*. Forestry Commission of NSW.
- Keith, D. 2002. *A compilation map of native vegetation for New South Wales*, Version 1.1, NSW Biodiversity Strategy, NSW Government.
- Keith, D.A., Williams, J.E. & Woinarski, J.C.Z. 2002. 'Fire management and biodiversity conservation: key approaches and principles' in Bradstock, R.A., Williams, J.E. & Gill, A.M. (eds) *Flammable Australia. The Fire Regimes and Biodiversity of a Continent*, Cambridge University Press, Cambridge, pp. 401-428.
- McElroy, C.T. 1969. The Clarence-Moreton Basin in New South Wales. *Journal of the Geological Society of Australia* **16**:457.
- Morrison, D.A., Cary, G.J., Pengelly, S.M., Ross, D.G., Mullins, B.J., Thomas, C.R. & Anderson, T.S. 1995. 'Effects of fire frequency on plant species composition of sandstone communities in the Sydney region: inter-fire interval and time-since-fire' in *Australian Journal of Ecology* **20**, pp. 239-247.
- Navin, K and Officer, K. 1990. *Archaeological Survey of Proposed 330kV Transmission Line from Coffs Harbour to Koolkhan (Grafton), NSW*. Report to the Electricity Commission of NSW.
- NSW National Parks and Wildlife Service. 1999. *Forest Ecosystem Classification and Mapping for the Upper and Lower North East CRA Regions*. A project undertaken for the Joint Commonwealth NSW Regional Forest Agreement Steering Committee as part of the NSW Comprehensive Regional Assessments. NSW National Parks and Wildlife Service, Coffs Harbour.
- NSW National Parks and Wildlife Service. 1999a. *Modelling Areas of Habitat Significance for Vertebrate Fauna and Vascular Flora in North-East NSW*. A project undertaken for the Joint Commonwealth NSW Regional Forest Agreement Steering Committee as part of the Comprehensive Regional Assessments. NSW National Parks and Wildlife Service, Coffs Harbour.
- NSW National Parks and Wildlife Service. 2001. *Key Habitats and Corridors for fauna as a framework for Regional biodiversity conservation planning in North-East NSW*. NSW National Parks and Wildlife Service, Coffs Harbour.

- NSW National Parks and Wildlife Service and State Forests of NSW. 2001. *Best Bush: Recreation map of the forests & parks of NSW*. A joint project by the NSW National Parks and Wildlife Service and State Forests of NSW.
- NSW National Parks and Wildlife Service. 2002. *Atlas of NSW Wildlife*. Geographic Information Systems Division, NSW National Parks and Wildlife Service, Hurstville.
- NSW National Parks and Wildlife Service. 2002a. *Draft North Coast Region Pest Management Strategy*. NSW National Parks and Wildlife Service, Hurstville, NSW.
- NSW National Parks and Wildlife Service. 2002b. *Threatened Species of the Upper North Coast of New South Wales: Flora*. NSW National Parks and Wildlife Service, Hurstville, NSW.
- NSW National Parks and Wildlife Service. 2002c. *The NPWS Approach to Fire Management Planning*. NSW National Parks and Wildlife Service.
- Paton, D. C. 1996. *Overview of Feral and Managed Honeybees in Australia: Distribution, Abundance, Extent of Interactions with Native Biota, Evidence of Impacts and Future Research*. Australian Nature Conservation Agency, p71
- Resource and Conservation Assessment Council. 1996. *Regional report of the Upper North East New South Wales: Volume 4 Biodiversity Attributes*. A report initiated by the Natural Resources Audit Council. New South Wales Government, Sydney.
- Riddler, A.M.H. and Hawkins, C.A. 1981. *Soil Survey Bulletin 6: Soil Landscapes in the Mid-Clarence Valley*. Department of Agriculture New South Wales.
- Scanlon, T. 2001. *Exotic Species Report – Newly Acquired Lands, NSW NPWS North Coast Region (Grafton)*. Report to the NSW National Parks and Wildlife Service.
- State Forests of New South Wales. 1995. *Proposed forestry operations in the Coffs Harbour and Urunga Management Areas Environmental and Fauna Impact Statement, Main Report, Volume A*. State Forests of NSW, Pennant Hills.

APPENDIX A: KEY HABITAT AND CORRIDOR PRIORITY FAUNA ASSEMBLAGES

Table A1 Moist escarpment – foothills fauna assemblage

Common Name	Scientific Name
glossy black cockatoo	<i>Calyptorhynchus lathami</i>
powerful owl	<i>Ninox strenua</i>
masked owl	<i>Tyto novaehollandiae</i>
spotted-tailed quoll	<i>Dasyurus maculatus</i>
koala	<i>Phascolarctos cinereus</i>
greater glider	<i>Petauroides volans</i>
yellow-bellied glider	<i>Petaurus australis</i>
rufous bettong	<i>Aepyprymnus rufescens</i>
grey-headed flying-fox	<i>Pteropus poliocephalus</i>
white-striped mastiff bat	<i>Nyctinomus australis</i>
little bentwing-bat	<i>Miniopterus australis</i>
common bentwing-bat	<i>Miniopterus schreibersii</i>
little vespadelus	<i>Vespadelus pumilus</i>

Source: NPWS 2001

Table A2 Dry coastal foothills fauna assemblage

Common Name	Scientific Name
green-thighed frog	<i>Litoria brevipalmata</i>
white-crowned snake	<i>Cacophis harriettae</i>
pale-headed snake	<i>Hoplocephalus bitorquatus</i>
black-necked stork	<i>Ephippiorhynchus asiaticus</i>
red goshawk	<i>Erythrorhynchus radiatus</i>
bush stone-curlew	<i>Burhinus grallarius</i>
musk lorikeet	<i>Glossopsitta concinna</i>
turquoise parrot	<i>Neophema pulchella</i>
little bronze-cuckoo	<i>Chrysococcyx malayanus</i>
forest kingfisher	<i>Todiramphus macleayi</i>
hooded robin	<i>Melanodryas cuculata</i>
grey-crowned babbler	<i>Pomatostomus temporalis</i>
yellow-tufted honeyeater	<i>Lichenostomus melanops</i>
brush-tailed phascogale	<i>Phascogale tapoatafa</i>
common planigale	<i>Planigale maculata</i>
squirrel glider	<i>Petaurus norfolcensis</i>
hoary bat	<i>Chalinolobus nigrogriseus</i>
little broad-nosed bat	<i>Scotorepens greyi</i>
broad-nosed bat	<i>Scotorepens sp.1</i>
eastern chestnut mouse	<i>Pseudomys gracilicaudatus</i>
New Holland mouse	<i>P. novaehollandiae</i>
pale field rat	<i>Rattus tunneyi</i>

Source: NPWS 2001

APPENDIX B: SOIL EROSION AND TERRAIN CHARACTERISTICS FOR TALLAWUDJAH AND FLAGGY CREEK NATURE RESERVES

Table B1 Potential soil erosion levels within the reserves.

Soil Landscape	Description	Topsoil Erodibility	Subsoil Erodibility
Erosional			
Kremnos	Sideslopes, 20-25° within both reserves, some slopes to 30° in Tallawudjah NR.	FC: Moderate Tw: Moderate	FC: High Tw: High
Colluvial			
Arthur's Gap	Within Tallawudjah NR only. Escarpments, sideslopes >25°, mostly steeper than 30°, in central reserve and some ridges/crests.	Tw: Mostly high. Extreme in escarpment areas.	Tw: Mostly high. Extreme in escarpment areas.
Residual			
Walkers Creek	Within Tallawudjah NR only. Ridges/crests.	Tw: Moderate	Tw: Moderate
Transferral			
Kooralbyn	Sideslopes mostly 15-20° within Tallawudjah NR. Drainage plain and sideslopes 10-15° within central east and northern Flaggy Creek NR.	FC: Moderate Tw: Moderate	FC: Moderate Tw: Moderate to high
Glenreagh	S-W corner of Flaggy Creek NR only. Sideslope of 15-20°.	FC: Moderate	FC: Moderate
Alluvial			
Orara	Floodplain areas in both reserves. Streambed in western part of Tallawudjah NR.	FC: Moderate Tw: Moderate	FC: Moderate Tw: Moderate

Source: Adapted from soil, slope and terrain maps, NSWSE 1995.

Note: FC = Flaggy Creek Nature Reserve; Tw = Tallawudjah Nature Reserve