

# **KOUKANDOWIE AND CHAMBIGNE NATURE RESERVES**

## **PLAN OF MANAGEMENT**

**NSW National Parks and Wildlife Service**

**Part of the Department of Environment and Conservation (NSW)**

**July 2006**

**This plan of management was adopted by the Minister for the Environment on 24<sup>th</sup> July 2006.**

### **Acknowledgments**

Many thanks to members of the North Coast Region Advisory Committee, neighbours and members of the community who contributed to the plan.

### **Further information**

For additional information or enquiries on any aspect of these reserves or this plan, please contact the NPWS North Coast Regional Office at level 3, 49 Victoria Street Grafton NSW. Telephone (02) 66411500. Postal address PO Box 361 Grafton NSW 2460.

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## FOREWORD

Koukandowie and Chambigne Nature Reserves are located in the Clarence Valley south west of Grafton on the New South Wales north coast. The reserves were established in 1999 following the North East Regional Forest Assessment which deemed them to be of high conservation value.

Koukandowie and Chambigne Nature Reserves include important areas of old growth forest in a mostly undisturbed condition and key habitats, as well as being an important part of several regional corridors. A total of 259 plant species have been recorded within Chambigne Nature Reserve, including 4 threatened species, while 42 species have been recorded within Koukandowie Nature Reserve. Surveys of Koukandowie Nature Reserve by NPWS in 2002 revealed the presence of 129 fauna species including 12 threatened species.

The reserves are also located in an area that is significant to Aboriginal culture which contains sites of national and regional importance.

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

A draft plan of management for Koukandowie and Chambigne Nature Reserves was placed on public exhibition from 23 April until 2 August 2004. The exhibition of the draft plan attracted 6 submissions that raised 13 issues. All submissions received were carefully considered before adopting this plan.

This plan of management establishes the scheme of operations for Koukandowie and Chambigne 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 Regulation 2002*, the *Threatened Species Conservation Act 1995* (TSC Act) and the policies of the National Parks and Wildlife Service (NPWS). Section 72AA of the NPW Act lists the matters to be considered in the preparation of a plan of management. The policies are compiled 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.

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

### 1.2 PURPOSE OF RESERVING LAND AND MANAGEMENT PRINCIPLES

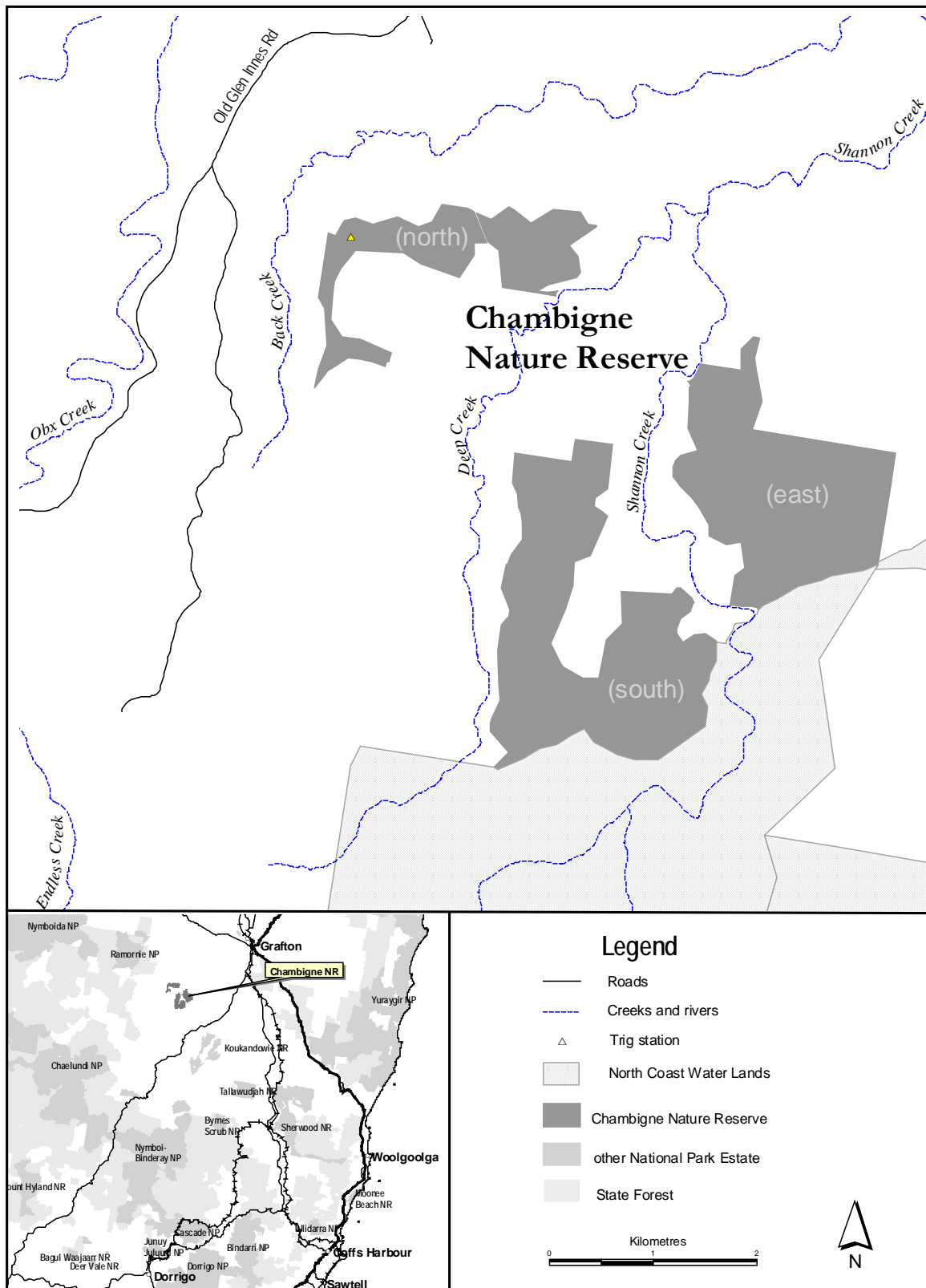
Nature reserves are reserved under the NPW Act to protect and conserve areas containing outstanding, unique or representative ecosystems, species, communities or natural phenomena.

Under the Act, nature reserves are managed to:

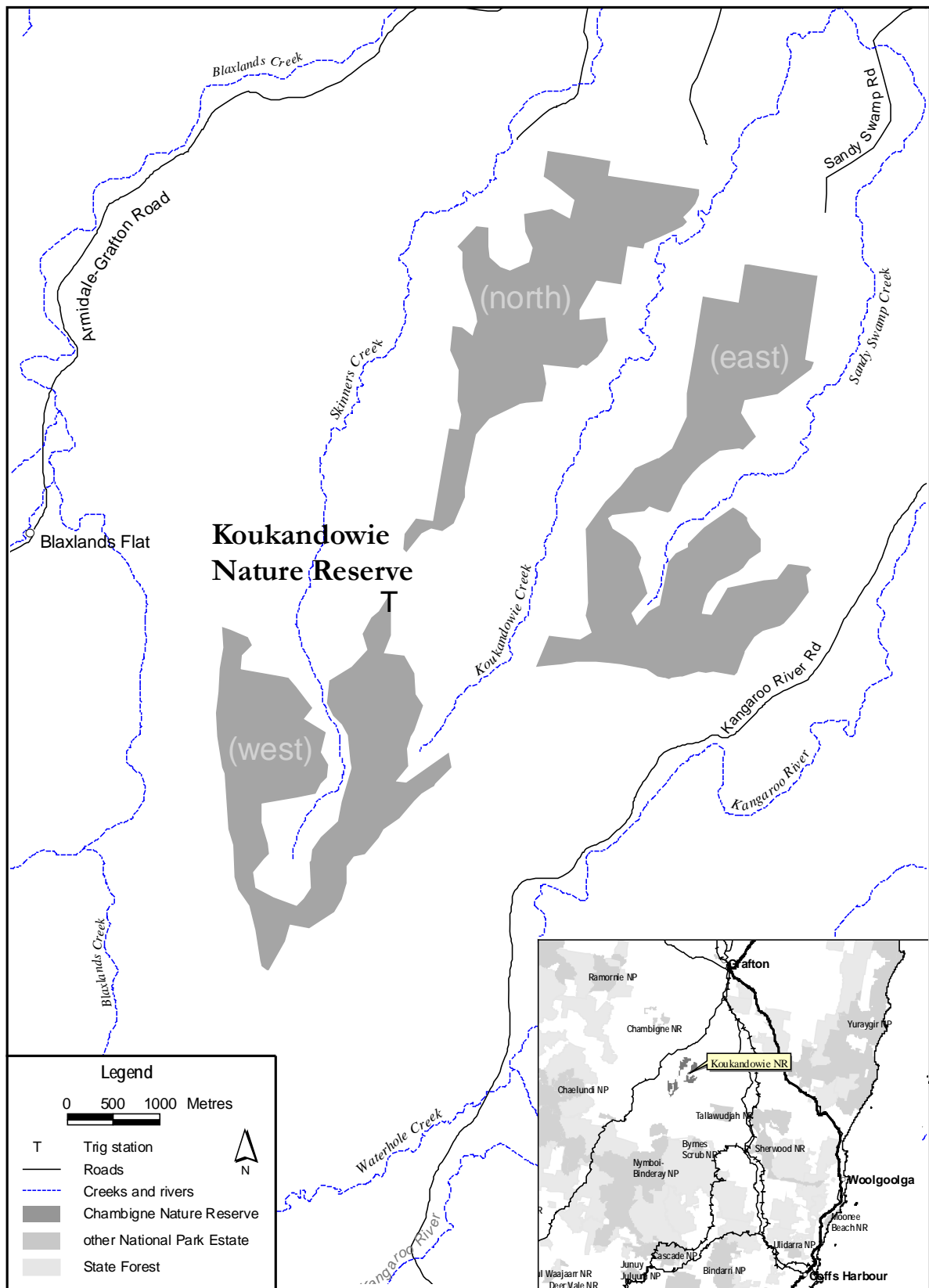
- conserve biodiversity, maintain ecosystem functions, and protect geological and geomorphological features and natural phenomena;
- conserve places, objects, features and landscapes of cultural value;
- promote public appreciation, enjoyment and understanding of the reserve's natural and cultural values;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

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

## 2. RESERVE AND LOCALITY MAPS



**Map A. Chambigne Nature Reserve and locality map**



**Map B. Koukandowie Nature Reserve**

### 3. KOUKANDOWIE AND CHAMBIGNE NATURE RESERVES

#### 3.1 LOCATION, GAZETTAL AND REGIONAL SETTING

Koukandowie and Chambigne Nature Reserves (referred to as “the reserves” in this plan) are located in the Clarence Valley, 22 kilometres and 18 kilometres respectively south-west of Grafton, on the New South Wales north coast (refer to map A).

The reserves were previously vacant crown lands, deemed to be of high conservation value under the assessment preceding the North East Regional Forest Agreement. The nature reserves were subsequently declared under the NPW Act on the 5<sup>th</sup> of March 1999, with subsequent additions including the northern tip of Koukandowie north and Chambigne east, both added in December 1999. Chambigne Nature Reserve now covers an area of 798 ha, while Koukandowie covers an area of 1283 ha and combined the reserves encompass a total area of 2081 hectares. Chambigne is the name of a French province, and this name was brought to the Clarence Valley and applied to one of the district’s early pastoral runs “Chambigne Station”.

The reserves are surrounded predominantly by freehold property, with several Crown leases and public land owned by North Coast Water (NCW). The reserves are important protected area islands within a developed agricultural landscape. Surrounding land uses include rural residential developments, cattle grazing, quarrying, silviculture, and water storage. Both reserves are in a relatively undisturbed condition, however some impacts associated with bushrock removal, cattle grazing, weed incursion and inappropriate fire regimes are apparent (refer to section 3.8).

The reserves lie within the highly significant Kangaroo Sandstone belt, a land system that is ecologically diverse and rich in plant and animal life unique to the locality.

Koukandowie and Chambigne Nature Reserves are similar in terms of landform, geographic position, natural values, social values and management issues, therefore they have been combined for the purposes of this plan. The reserves sit within the Clarence Valley Local Government Area, the Northern Rivers Catchment Management Authority area and the Grafton Ngerrie Local Aboriginal Land Council boundaries.

#### **Regional Forest Agreements**

Regional Forest Agreements (RFA) are one of the principle 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. This aimed 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 both Koukandowie and Chambigne 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.

The geology, landform, climate and plant and animal communities of the area, plus its location, have determined how humans have used it. The landscape features, together with the plant and animal communities of the area enabled occupation and use by Aboriginal people.

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**

- Manage the reserves as part of a regional network of reserves with similar geological, botanical and cultural attributes including Sherwood, Tallawudjah and Flaggy Creek Nature Reserves.
- Manage the reserves as a model for successful management of protected areas with difficult boundary alignments in an agricultural context.
- Conservation of a stable core of undisturbed natural systems within a modified agricultural landscape.
- Conservation of sustainable, viable and robust populations of threatened species within and adjacent to the reserves.
- Encourage awareness and appreciation of the reserves values among neighbours and the local community.
- Mitigate bushfire risk to people and infrastructure.
- Apply appropriate fire regimes for conservation of plant and animal communities, particularly threatened species.



### 3.4 NATURAL AND CULTURAL HERITAGE

#### Landform, Geology and Soils

The reserves are situated within the escarpment range foothills land system. This landform zone falls between the coastal and valley floor lowlands to the north-east and the upland ranges and escarpment to the west (ERM Mitchell McCotter, 1999). The reserves comprise gently undulating to hilly areas, with rocky pinnacles, a number of long narrow elevated sandstone plateaus with associated cliffs, broken rock shelves, steep slopes and stony ridges sitting high above undulating valley floors.

The characteristic sandstone ridges within the Chambigne area were named “the reefs” by the local community (Coutts Crossing and Nymboida Districts Historical Society 1995). Elevation ranges from 50 to 445 metres above sea level with the locally well-known Koukandowie Nature Reserve rocky feature, Wards Point, rising to 375 metres above sea level.

Within the valley floors lie Shannon, Deep, Skinners, Sandy Swamp and Koukandowie Creeks, which feed into the Orara River within the greater Clarence River catchment. The reserves play a role in protection of associated aquatic and riparian systems, while also contributing ultimately to the domestic water supply of Grafton. Small ephemeral and perennial elevated swamps are also scattered throughout the area.

The reserves lie within the extensive New England fold belt, a geological formation stretching from the NSW central coast to southern Queensland, which was formed in the late Paleozoic era approximately 260 million years ago (NPWS 1993). Superimposed within the New England Fold belt, lies the Clarence–Moreton basin, a formation laid down during the late Triassic period approximately 180 million years ago (NPWS 1993). This formation comprises sandstone, shale / siltstone / claystone with conglomerate and coal measures (ERM Mitchell McCotter, 1999). The Kangaroo Creek and Grafton sandstones, the two youngest formations within the Clarence–Moreton basin, were deposited in the Jurassic and Cretaceous periods approximately 140 million years ago (Veness and Associates, 1994).

The reserves lie on the south-west portion of the Clarence–Moreton basin between the more resistant Kangaroo Creek Sandstone and the underlying Walloon coal measures. The Kangaroo Creek Sandstone has weathered to form steep slopes and variable upper slope escarpments, while the Walloon coal measures have formed the moderate to low gradient areas (ERM Mitchell McCotter, 1999).

Sandy loam soils dominated the reserves, with varying densities of gravels, and clays derived from the underlying sandstones and conglomerates. Soils formed on the Kangaroo Creek Sandstone are generally thin, while soils on the Walloon coal measures are usually thicker (ERM Mitchell McCotter, 1999). These loamy soils are both infertile and highly erodible.

Climate is warm temperate maritime with a summer autumn rainfall peak (January to March) The area receives an annual rainfall of approximately 1029 mm and a mean temperature range of 25.6 to 13.1 degrees Celsius.

The reserves lie within the NSW North Coast bioregion, containing a diversity of natural systems including rangelands, hills, coastal plains and sand dunes with tall open forests, open forests, woodlands, rainforest, wetlands, and heaths. Within the bioregion, natural ecosystems are present but coexisting with pastoral and timber industries (Environment Australia Website, 2001).

### **Aboriginal Heritage**

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

The Clarence Valley is significant to Aboriginal culture, with a diverse and rich history of land use by Aboriginal people. Surveys adjacent to the reserves suggest the reserves may contain significant cultural heritage values. Koukandowie and Chambigne Nature Reserves lie within the traditional lands of the Gumbaynggir people, today represented by the Burraway Wadjard Elders and members of the Grafton Ngerrie Aboriginal Local Area Land Council.

The earliest Aboriginal occupation site recorded in the region is the Seelands Rock shelter west of Grafton, dating to 6400 years before present. The Clarence Valley is known to contain many sites of national and regional importance, notably the Bull Paddock/Middle Creek bora ground area most likely used as travel paths for peoples moving between the Orara River and Blaxlands Creek. Sites in the area have been listed on the register of the National Estate, including stone arrangements and rock art sites (ERM Mitchell McCotter 1998).

Two cultural heritage sites have been recorded on Koukandowie Nature Reserve and one additional site is recorded directly adjacent to this reserve. One site has been recorded on Chambigne Nature Reserve, with 53 sites recorded on adjacent lands. It is expected that many sites remain undetected within both reserves.

### **Non-Aboriginal Heritage**

The Clarence Valley was intensively explored by early cedar cutters in the mid-1830s, who followed the fertile alluvial soils upstream along the north coast rivers in pursuit of cedar. Support infrastructure soon began to develop, such as shipping ports, established on the larger rivers throughout the NSW North Coast in the 1840s and 1850s.

In the 1840s large pastoral holdings were established in the Clarence Valley, initially producing wool then tallow (Blackmore & Associates 1993). Towards the end of the

decade, sheep were superseded by cattle, an industry that has persisted to this day. Nearby Chambigne Station dates back to 1848 when, at its peak, it encompassed an area of 50000 hectares (Coutts Crossing and Nymboida Districts Historical Society 1995).

In 1861 the creation of the Robertson Land Act resulted in the large leasehold pastoral runs being replaced by smaller selectors, who developed more marginal agricultural country (ERM Mitchell McCotter 1999) and moved into production of dairy products, pigs, maize and cotton. Nearby Blaxlands Flat and Chambigne schools were set up in 1885 and 1894 respectively, in line with the increasing infrastructure momentum. In 1886, Rockview Station was established to the immediate south of Chambigne Nature Reserve south, and was initially involved in dairying and pig production.

Contemporary land use adjacent to the reserves remains predominantly cattle grazing and timber production, with ongoing residential and hobby farm development. The reserves have remained relatively untouched in the face of the past 160 years of European development activity primarily due to their limited agricultural value.

No known significant non-Aboriginal heritage sites occur within the reserves, however a number of significant sites and items such as farmhouse complexes from the late 1800s and early 1900s occur south-east of Chambigne south (ERM Mitchell McCotter 1999), demonstrating the past agricultural use of the wider area. Several contemporary European features have been noted on the reserves. These include a short gravel road that transects Chambigne north, two trigonometrical stations – one in each reserve (refer to section 3.6), disused dead end vehicular trails in Koukandowie east and north, small sections of fence throughout various sections of both reserves, and anecdotal evidence of local stock movement routes (Hunt 2000, pers. comm).

## **Native Plants**

North-eastern New South Wales is a biogeographical overlap zone of particular interest, given the great number of plants and animals that reach their distributional limits in this area. The area is biodiverse and supports a mix of both temperate and subtropical biota (NPWS 1995).

The Kangaroo Creek Sandstone formation, on which the reserve is located, is known for endemic, rare and threatened plants. The plants of this formation are highly diverse floristically (ERM Mitchell McCotter 1998).

Various research projects and other information gathering efforts have been undertaken in and around the reserves including:

- surveys undertaken for the Natural Resources Audit Council provided site specific botanical information including species lists and plant community descriptions;
- incidental survey by various persons and groups throughout both reserves, with information recorded on the NPWS Atlas;
- NPWS fauna survey undertaken within Koukandowie Nature Reserve in 2002;

- ongoing plant surveys by local amateur botanists within Chambigne Nature Reserve;
- targeted surveys of the *Grevillea beadleana* population undertaken by NPWS annually;
- information collected in preparation for the Environmental Impact Statement (EIS) for the Shannon Creek dam development, which provides a further insight into the values of Chambigne Nature Reserve south and east; and
- neighbours have provided information on a range of issues including plants and animal distribution and abundance, cultural heritage both Aboriginal and European and pest species.

Koukandowie Nature Reserve encompasses areas of old growth that conserves vulnerable forest ecosystems in a mostly undisturbed condition (NPWS 1999). A full list of plant communities found in the reserves and their dominant species is shown in Table 1.

**Table 1** Plant communities found in the reserves and their dominant species

| Plant Community  | Dominant species   |
|--|--|
| Blackbutt / tallowwood woodland  | <i>Eucalyptus pyrocarpa</i> , <i>E. pilularis</i> , <i>E. microcorys</i>   |
| Blackbutt / stringybark / red bloodwood Woodland   | <i>Eucalyptus pyrocarpa</i> , <i>E. planchoniana</i> , <i>E. baileyana</i> , <i>E. gummifera</i>                     |
| Square fruited ironbark woodland   | <i>Eucalyptus tetrapleura</i>  |
| Spotted gum / bastard mahogany / red bloodwood woodland  | <i>Eucalyptus maculata</i> , <i>E. psammitica</i> , <i>E. gummifera</i>  |
| Blackbutt / spotted gum / ironbark woodland  | <i>Eucalyptus pyrocarpa</i> , <i>E. maculata</i> , <i>E. siderophloia</i>  |
| Pink bloodwood / red gum woodland  | <i>Eucalyptus intermedia</i> , <i>E. tereticornis</i> , <i>E. amplifolia</i> ssp <i>sessilifloris</i>                |
| Sandstone white mahogany / brown bloodwood woodland (preliminary listed as an endangered ecological community) | <i>Eucalyptus psammitica</i> , <i>Corymbia trachyphloia</i>  |
| Red gum / grey box / Grafton stringybark woodland  | <i>Eucalyptus tereticornis</i> , <i>E. seeana</i> , <i>E. amplifolia</i> , <i>E. moluccana</i> , <i>E. tindaliae</i> |
| Tallowwood / white mahogany / ironbark / brushbox dry sclerophyll forest                                       | <i>Eucalyptus microcorys</i> , <i>E. acmenoides</i> , <i>E. crebra</i> , <i>Lophostemon confertus</i>                |
| Paperbark swamp  | <i>Melaleuca alternifolia</i> , <i>M. quinquenervia</i> , <i>M. sieberi</i>  |
| Heath woodland   | <i>Banksia serrata</i> , <i>B. integrifolia</i> , <i>Angophora robur</i>   |

NPWS 1995

Forty-two plant species have been recorded within Koukandowie Nature Reserve including one ROTAP (Briggs and Leigh 1988) and one vulnerable species.

A total of 259 plant species have been recorded within Chambigne Nature Reserve, including two endangered, two vulnerable, two ROTAPS and the significant yet undescribed *Bertya sp.nova*, which is likely to be scheduled as endangered. The *Corymbia trachyphloia* – *Eucalyptus psammitica* open woodland plant community

also grows within the reserve and has preliminary listing as an endangered ecological community. A new species, *Boronia hapophylla*, has recently been described. This plant grows in small areas within Chambigne Nature Reserve (east and south sections) and may be considered for listing under the TSC Act (Westaway pers. comm. 2003).

Further information is required on the plants of Koukandowie Nature Reserve, as it is likely that many species associated with the Kangaroo Creek Sandstone formation also occur within this reserve.

**Table 2** Significant plant species recorded and likely to occur within the reserves

| Species                           | Common name                  | TSC Act or other status  |
|-----------------------------------|------------------------------|--|
| <b>Koukandowie Nature Reserve</b> |                              |  |
| <i>Olearia stilwelliae</i>        | red-leafed daisy bush        | ROTAP  |
| <i>Angophora robur</i>            | sandstone rough-barked apple | Vulnerable   |
| <i>Acacia ruppii</i> *            |                              | Endangered   |
| <i>Melichrus hirsutus</i> *       |                              | Vulnerable   |
| <i>Boronia chartacea</i> *        |                              | Rare <sup>+</sup>  |
| <i>Callistemon acuminatus</i> *   |                              | Rare <sup>+</sup>  |
| <b>Chambigne Nature Reserve</b>   |                              |  |
| <i>Grevillea beadleana</i>        |                              | Endangered   |
| <i>Melichrus hirsutis</i>         |                              | Endangered   |
| <i>Bertya sp.nova</i>             |                              | Undescribed  |
| <i>Eucalyptus psammitica</i>      | sandstone white mahogany     | ROTAP  |
| <i>Angophora robur</i>            |                              | Vulnerable   |
| <i>Callistemon acuminatus</i>     |                              | ROTAP  |
| <i>Eucalyptus tetrapleura</i>     | square-fruited ironbark      | Vulnerable   |
| <i>Dodonaea hirsuta</i>           |                              | Rare <sup>+</sup>  |
| <i>Boronia hapophylla</i>         |                              | May be considered for listing as a threatened species <sup>^</sup> |

\* Predicted to occur (NPWS 1999)

<sup>+</sup> Sheringham & Westaway 1995

<sup>^</sup> Westaway pers. comm. 2003

Clearing of vegetation within the bioregion has resulted in a high loss of biodiversity and fragmentation of habitat. Long term conservation of biodiversity depends upon the protection, enhancement and connection of remaining habitat across the landscape, involving vegetation remnants on both public and private lands. Nearby vegetated areas consolidate the habitat values of the reserve and provide ecological corridors to other surrounding forested areas.

## Native Animals

Despite the area's low nutrient base, the reserves contain a diverse and abundant fauna. Supporting habitat features include:

- diversity of microhabitats from aquatic/riparian to cliffs, rock tumbles, incised gullies, shelves, dry ridges and plateaus;
- old growth attributes including large mature trees and dead trees with large variable hollows;
- protected area islands providing a stable core of undisturbed natural systems with associated connectivity with broader vegetated areas on adjacent private property and public lands;
- permanent water sources;
- productive plant communities, particularly heath and woodlands, providing perennial direct and indirect food sources;
- diversity of plant communities from heath to moist forest pockets; and
- the relatively undisturbed, intact and stable condition of the natural systems within the reserves.

Surveys of Koukandowie Nature Reserve by NPWS in 2002 revealed the presence of 129 fauna species with 12 species listed as threatened under the TSC Act. Three additional threatened species are likely to occur within Koukandowie Nature Reserve (Table 3). Two threatened fauna species have been recorded in Chambigne Nature Reserve with three predicted by modelling to occur (Table 3). A further 21 threatened fauna species recorded on adjacent NCW lands (Table 4) are also expected to occur within Chambigne Nature Reserve.

The NPWS has identified a series of key habitats and corridors throughout the NSW North Coast (NPWS 2000). Koukandowie and Chambigne Nature Reserves are part of several regional vegetation corridors. These corridors contain fauna movement links between disjunct protected areas, including the planning area, Ramornie National Park to the north west, Nymboi Binderay National Park to the south west and forest habitats adjacent to these areas. Vegetated private and public lands surrounding the reserves are also vital to the connectivity of fauna habitats in the region.

Koukandowie Nature Reserve sits within or adjacent to six regional level corridors based upon the dry foothill and moist escarpment fauna assemblages. Chambigne Nature Reserve sits within one subregional and one regional level corridor based upon the dry foothill fauna assemblage. These fauna assemblages are combinations of significant species with similar predicted distributions. Important fauna assemblage species for both reserves include brush-tailed phascogale, rufous bettong and the yellow-bellied glider. Chambigne east contains highly significant habitat for the dry foothill assemblage of fauna. Limited information is available on the invertebrate and herpeto fauna of the reserves.

**Table 3** Threatened fauna species recorded and likely to occur in the reserves

| Common name                     | Scientific name                | Reserve     | TSC Act status |
|---------------------------------|--------------------------------|-------------|----------------|
| <b>Species known to occur*</b>  |                                |             |                |
| Little bent wing bat            | <i>Miniopterus australis</i>   | Koukandowie | vulnerable     |
| Greater broad-nosed bat         | <i>Scoteanax ruepellii</i>     | both        | vulnerable     |
| Grey headed flying fox          | <i>Pteropus poliocephalus</i>  | Koukandowie | vulnerable     |
| Koala                           | <i>Phascolarctos cinereus</i>  | Koukandowie | vulnerable     |
| Squirrel glider                 | <i>Petaurus norfolcensis</i>   | Koukandowie | vulnerable     |
| Brush-tailed rock-wallaby       | <i>Petrogale penicillata</i>   | both        | endangered     |
| Glossy black cockatoo           | <i>Calyptorhynchus lathami</i> | Koukandowie | vulnerable     |
| Yellow bellied glider           | <i>Petaurus australis</i>      | Koukandowie | vulnerable     |
| Powerful owl                    | <i>Ninox strenua</i>           | Koukandowie | vulnerable     |
| Grey crowned babbler            | <i>Pomatostomus temporalis</i> | Koukandowie | vulnerable     |
| Masked owl                      | <i>Tyto novaehollandiae</i>    | Koukandowie | vulnerable     |
| Rufous bettong                  | <i>Aepyprymnus rufescens</i>   | Koukandowie | vulnerable     |
| <b>Species likely to occur*</b> |                                |             |                |
| Brushed-tailed phascogale       | <i>Phascogale tapoatafa</i>    | Koukandowie | endangered     |
| Eastern cave bat                | <i>Vespadelus troughtoni</i>   | Koukandowie | vulnerable     |
| Common planigale                | <i>Planigale maculata</i>      | Koukandowie | vulnerable     |
| Masked owl                      | <i>Tyto novaehollandiae</i>    | Chambigne   | vulnerable     |

\* NPWS 2002e; + NPWS 1999

**Table 4** Threatened species recorded adjacent to Chambigne Nature Reserve and therefore likely to occur within the reserve

| Common name                          | Scientific name                   | TSC Act status |
|--------------------------------------|-----------------------------------|----------------|
| Glossy black cockatoo *              | <i>Calyptorhynchus lathami</i>    | vulnerable     |
| Hoary bat *                          | <i>Chalinolobus nigrogriseus</i>  | vulnerable     |
| Tiger quoll +                        | <i>Dasyurus Maculatus</i>         | vulnerable     |
| Brush-tailed phascogale +            | <i>Phascogale tapoatafa</i>       | endangered     |
| Rufous bettong +                     | <i>Aepyprymnus rufescens</i>      | vulnerable     |
| Koala +                              | <i>Phascolarctos cinereus</i>     | vulnerable     |
| Yellow-bellied glider +              | <i>Petaurus australis</i>         | vulnerable     |
| Squirrel glider +                    | <i>Petaurus norfolcensis</i>      | vulnerable     |
| Little bent wing bat +               | <i>Miniopterus australis</i>      | vulnerable     |
| Yellow bellied sheathed tailed bat + | <i>Saccolaimus flaviventris</i>   | vulnerable     |
| Undescribed freetail bat +           | <i>Mormopterus sp.</i>            | vulnerable     |
| Eastern falsistrelle +               | <i>Falsistrellus tasmaniensis</i> | vulnerable     |
| Large footed myotis +                | <i>Myotis adversus</i>            | vulnerable     |
| Troughton's eptesicus +              | <i>Vespadelus troughtoni</i>      | vulnerable     |
| Large pied bat +                     | <i>Chalinolobus dwyeri</i>        | vulnerable     |
| Large bent-winged bat +              | <i>Miniopterus schreibersii</i>   | vulnerable     |
| White-crowned snake +                | <i>Cacophis harriettae</i>        | vulnerable     |
| Barking owl +                        | <i>Ninox connivens</i>            | vulnerable     |
| Black bittern +                      | <i>Dupetor flavicollis</i>        | vulnerable     |
| Powerful owl +                       | <i>Ninox strenua</i>              | vulnerable     |
| Masked owl +                         | <i>Tyto novaehollandiae</i>       | vulnerable     |

\* NPWS atlas 2002, + ERM Mitchell McCotter 1998

### **3.5 VISITOR USE**

The reserves are surrounded by private property, except for public lands owned by NCW adjacent to Chambigne Nature Reserve. Consequently, access to the reserves is available currently only to direct neighbours. On completion of the Shannon Creek dam in several years, the public will have access indirectly to Chambigne Nature Reserve via NCW lands.

Limited numbers of neighbours and locals have used the reserves over the years for recreation, including bushwalking and picnicking. There are no visitor facilities in the reserves.

Recreational activities not consistent with the study of nature and natural environments are generally considered inappropriate uses of a nature reserve. Recreational opportunities or facilities will not be provided within the reserves. It is anticipated that the proposed Shannon Creek Dam will provide appropriate recreational opportunities in the area.

Development of the Shannon Creek dam includes creation of roads and visitor facilities. It is anticipated this development will generate pressures on the southern and eastern portions of Chambigne Nature Reserve in the form of edge effects such as pest species, recreational use and noise (refer to Section 3.7).

Neighbours have advised of persons accessing the reserves through their properties without consent, and their concerns for this issue to worsen as the reserves gain profile.

### **3.6 NON-NPWS USE**

#### **Trigonometrical Stations**

Survey trigonometrical stations are located at Wards Point (Koukandowie Nature Reserve west) and Chambigne Mountain (Chambigne Nature Reserve north). These stations predate gazettal of the reserves. The Land & Property Division of the NSW Department of Lands owns the stations. It is unlikely that the stations will be used or require future maintenance, however access and maintenance by the Department of Lands is provided for under a formal agreement between the Department of Lands and NPWS.

### **3.7 MANAGEMENT OPERATIONS**

#### **NPWS Access**

NPWS access to all sections of the reserves for management purposes relies primarily on the goodwill of neighbours. Crown road easements transect all three sections of Koukandowie Nature Reserve and the north and east sections of Chambigne Nature Reserve, however none of the Crown roads is formed.



Consequently there is no legal public road access to the reserves. NPWS access to the reserves using the existing trail network relies upon agreement with private landholders. The NPWS contributes to the maintenance of key access roads on a cost share basis with neighbours and local government.

## **Boundary Alignment**

The boundaries of the reserves, are long convoluted administrative lines that follow the base or mid-slope of the rocky escarpment, encircling the sandstone plateaus and transecting numerous gullies and creeks. There is a very high reserve boundary to area ratio, as the reserves total 2081 hectares with a boundary length of approximately 75 kilometres. This represents substantial edge effects whereby external influences can effect the entire reserve area.

The boundary alignments do not provide for integration of natural systems such as sandstone ridges, rocky slopes, valley floors and creeks. They do not provide for mid to upper slope fauna species that live on the reserves and also use adjacent valley floors, ie brush-tailed rock-wallabies.

The topography on the boundary alignment represents significant difficulties in managing cross boundary issues such as fire and stock. Neighbours too have difficulty applying their legitimate land management practices without impinging on the reserves, in the absence of physical controls such as fencing and fire control lines. Neighbours frequently advise of their confusion over the boundary location and the alignment invariably requires placement of fire control lines on neighbouring lands, where suitable terrain exists. Strong cooperative neighbour support is paramount in managing cross boundary issues without effective control infrastructure.

## **Neighbours**

Contemporary land use adjacent to the reserves remains predominantly cattle grazing and timber production, with ongoing residential and hobby farm development. Koukandowie Nature Reserve is surrounded by nineteen neighbours, Chambigne Nature Reserve by eight. The NPWS recognises the importance of neighbour support in management of the reserves on a broad range of issues. Neighbours have assisted and continue to assist with issues including providing NPWS access to the reserves, supply of both historical and contemporary information, cooperation in terms of fire management including fire detection and control.

One neighbour relies upon the trail through Chambigne North to access his property.

Following gazettal of the reserves, managers undertook a neighbour contact program involving mail outs, contacting the local communities through Rural Fires Brigades, working with neighbours on specific projects and individually meeting with neighbours on site.

## Shannon Creek Dam Project

A large project adjacent to Chambigne Nature Reserve is currently under way. NCW is upgrading the water supply system for the 90000 people living in the Grafton, Lower Clarence valley and Coffs Harbour areas. The project involves construction of a water storage dam, a pipeline linking the dam to the Nymboida River and the coastal consumers, as well as construction of a range of ancillary support infrastructure including roads, visitor facilities and pumping stations. NCW has undertaken an environmental impact assessment of the project. The NPWS is one of several determining authorities actively involved in ensuring minimal project impacts upon threatened species, the reserve system and cultural heritage assets.

The 37500 megalitre Shannon creek dam will be positioned immediately adjacent to the southern face of Chambigne Nature Reserve south. The dam inundation zone will cover an area of 210 hectares, with the large earthen dam wall and associated spillway positioned within 200 metres of the nature reserve boundary. The dam wall will be constructed from soil excavated from the site and imported gravel and rock. NCW has purchased lands to accommodate the inundation area, pipeline, access roads, inundation area buffer zone and compensatory habitat. The dam project represents both potential impacts and some benefits to the reserve that include:

### Potential impacts

- Disturbance to wildlife and habitat associated with dam construction including noise and vibration from blasting and heavy plant, particularly to the brush-tailed rock-wallabies in and adjacent to the reserve.
- Modification of vegetation adjacent to the reserve, that may weaken wildlife corridor opportunities.
- Edge effects associated with the proposal, particularly the creation of access roads, visitor facilities and the ancillary opportunities for viable subdivision of lands adjoining NCW.
- New and persistent pressures on Chambigne Nature Reserve from proposed visitor precincts and associated recreational use, particularly the potential recreational node below the dam wall.

### Potential benefits

- Interpretive and educational opportunities to raise awareness of the values of the Kangaroo Creek Sandstone area and the reserve system that protects small representative samples.

## 3.8 THREATS TO RESERVE VALUES

### Fire

The NPWS regards fire as a natural phenomenon and one of the continuing physical factors influencing the Australian environment. Inappropriate fire regimes have been identified as a key threatening process affecting the biological diversity of NSW. Fire is the dominant management issue on both reserves with substantial areas of the reserves burnt annually. Since 2001, approximately 85% of Koukandowie Nature Reserve has burnt in eight separate fire events and approximately 65% of

Chambigne Nature Reserve has burnt in three separate fire events. These severe fire events have originated west of the reserves in the Buccarumbi and Doboy areas and have been carried into the area under intense westerly winds. Anecdotal information suggests broad scale fire events affect the area every decade. Fires usually persist throughout entire individual sections of the reserves in a single fire event.

The bushfire danger period commences early September and closes early March (CVBFMC 2002). Historically, fire regimes have been driven by adjacent landholders applying fire to sustain pasture, protect assets, control weeds and reduce fuels with regimes ranging from one to three years. It is difficult to manage fire movement into and out of the reserves boundaries due to the steep rough terrain along boundary alignments that hinder access and establishment of control lines. Lack of fire control mechanisms on reserve boundaries inhibits both the NPWS and the reserve neighbours in applying their desired fire regimes.

The NPWS has been active in fire management within and adjacent to the reserves. This has included establishment and maintenance of a fire control line system, trialing of various control line types in the difficult terrain, close liaison with neighbours regarding fire management and control of fires within and adjacent to the reserves. Neighbours and the NPWS continue to develop the important fire control system, however the terrain dictates placement primarily upon neighbouring land.

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 (CVBFMC). 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. The NPWS is a fire authority under the *Rural Fires Act 2002* (RF Act) that is required to implement the provisions of district fire management plans.

The Clarence Valley Bush Fire Risk Management Plan assigns the reserves a high bush fire hazard ranking based on vegetation, slope, aspect and prevailing weather conditions. Lands immediately surrounding the reserves vary in bushfire hazard ranking from high to low, reflecting the proportion of vegetated areas remaining.

The reserves are surrounded by a sparsely populated rural community with a range of assets spread throughout the area. Fire typically move onto the reserves from adjoining lands, however fires moving through Koukandowie Nature Reserve have threatened infrastructure in the past (Brown pers. comm. 2001). Assets adjacent to the reserves include:

- isolated residences and associated infrastructure at a number of locations within one kilometres of the reserves;
- rural subdivision with residences adjacent to Koukandowie Nature Reserve along Kangaroo Creek road and south western side of Chambigne Nature Reserve;
- adjacent pasture and stock;
- Shannon Creek dam and buffer zone adjacent to Chambigne Nature Reserve;

- stock fences;
- hardwood timber plantation encircled by Koukandowie Nature Reserve;
- the proposed Shannon Creek dam, catchment and infrastructure adjacent to Chambigne Nature Reserve.

Existing fire regimes on the reserves, while providing some burn mosaic and fuel reduction benefits, are not compatible with the significant natural values of the reserves. Fire sensitive species and species requiring fire to trigger germination, are the most seriously affected by inappropriate fire regimes. Too frequent burning can reduce the vigour of even fire-adapted species. It is suggested that a fire free period of ten years may be required by many fire sensitive species to mature, flower and set viable seed store (T. Auld pers comm as cited in NPWS 1995:136).

The existing fire regimes appear to have effects on the two key reserve plant species, with a reduction in numbers and range of the *Grevillea beadleana* and the undescribed *Bertya sp. nova* populations within Chambigne Nature Reserve. Both species appear to be in retreat and grow only in fire refuge areas, their isolation and limited numbers make them vulnerable to fire and other stochastic events (NPWS 2002a & c). The *Grevillea beadleana* may maintain a seed bank under a six-year fire regime, however a fire regime of 15 years may be optimal to allow the maturation and expansion of the population while avoiding dominance of senescent age classes (NPWS 2002a). Little is known of the fire ecology of the *Bertya sp. nova*, however intense fire regimes are likely to threaten the species (Fatemi pers. comm. 2003). Intense fire regimes are implicated in restricting numbers and range of *Bertya sp. Cobar-Coolabah* in nearby Kangaroo River State Forest (NPWS 2002c).

Existing intense fire regimes represent a threat to a range of natural values within the reserves including:

- endemic species such as *Eucalyptus tetrapleura*, *Angophora robur* and *Melichrus hirsutis* (NPWS 2002b);
- moist forest communities adjacent to the reserves on creek lines and gullies;
- brush-tailed rock wallabies brush-tailed phascogale, with removal of protective vegetative cover and a reduction of immediate availability of grasses and forbs;
- Aboriginal cultural heritage sites may be directly affected by smoke and heat, as well as indirectly through removal of vegetative and soil cover (CVBFMC 2002); and
- the floristic structure, composition and diversity that in turn supports the range of invertebrate, mammal, reptile and bird fauna within the reserves.

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, which marks a critical change from high species diversity to low species diversity. The fire regime guidelines in Table 5 have been identified for the reserves.

**Table 5 Fire Regime Guidelines for major vegetation communities**

| Plant Community            | Minimum Fire interval in years | Maximum Fire Interval in years | Comment   |
|----------------------------|--------------------------------|--------------------------------|---|
| Woodland                   | 6                              | 30                             | Decline in biodiversity is expected if there is: <ul style="list-style-type: none"> <li>• Two or more fires that totally scorch or consume tree canopy</li> <li>• Three or more consecutive fires of low intensity</li> </ul> |
| Dry sclerophyll forest     | 5                              | 30                             | Decline in biodiversity is expected if there is: <ul style="list-style-type: none"> <li>• Two or more fires that totally scorch or consume tree canopy</li> <li>• Three or more consecutive fires of low intensity</li> </ul> |
| Dry forest rocky outcrop   | 10                             | 50                             | Decline in biodiversity is expected if there is: <ul style="list-style-type: none"> <li>• Two or more fires that totally scorch or consume tree canopy</li> <li>• Three or more consecutive fires of low intensity</li> </ul> |
| Swamp schlerophyll forest* | 7                              | 35                             | Decline in biodiversity is expected if there is: <ul style="list-style-type: none"> <li>• Two or more fires that totally scorch or consume tree canopy</li> <li>• Three or more consecutive fires of low intensity</li> </ul> |
| Heath woodland+            | 8                              | 15                             | Decline in biodiversity is expected if there is: <ul style="list-style-type: none"> <li>• Two or more fires that totally scorch or consume tree canopy</li> <li>• Three or more consecutive fires of low intensity</li> </ul> |
| Riparian                   |                                |                                | Exclude prescribed burning natural wildfire will provide appropriate frequency  |

\* NPWS 2002, + Bradstock et al 1995, Keith 1993 as cited in NPWS 1999.

A variable fire regime within these thresholds is required to avoid species decline. This requires varying fire frequency, intensity, season and burn pattern (Bradstock et al. 1995 & Keith 1996 as cited in Clarence Valley Bushfire Management Committee 2002).

General fire management safeguards for threatened natural values of the reserves are:

1. Avoid burning more than 25% of habitat in single fire event.
2. Maintain burn mosaic across the reserves.
3. Ensure fire regime for surrounding plant community is applied.
4. Avoid burning area >50% of the smaller home range of the species.
5. Avoid burning within breeding seasons.
6. Avoid high intensity fire by minimising the size of wildfires and suppressing wildfire before it affects threatened species habitat.
7. Avoid canopy scorch.
8. Avoid damage to hollow bearing, dead and den trees during fire activities.
9. Avoid intense fire adjacent to aboriginal art sites.
10. Avoid wildfire and fire control activity adjacent to cultural heritage sites. (NPWS 2000).

Where special fire management provisions are known for threatened species, these provisions should be applied to those areas known to contain these species. Those provisions currently suggested for specific species are listed in Table 6.

**Table 6** Specific fire management provisions for threatened species

| Species                    | Minimum fire interval | Maximum fire interval | Special provisions  |
|----------------------------|-----------------------|-----------------------|---|
| <i>Grevillea beadleana</i> | 15                    | To be determined      | Minimum 15 year fire regime*.   |
| <i>Melichrus hirsutis</i>  | 6                     | 30                    |   |
| <i>Bertya sp.nova.</i>     | To be determined      | To be determined      | Fire exclusion until further notice   |
| Brush-tailed phascogale    |                       |                       | Avoid burn patch size >10 hectares <sup>+</sup>   |
| Brush-tailed rock wallaby  |                       |                       | Exclude fire from shelter sites.<br>Maintain mosaic of grassy feed areas.<br>Where possible apply fire regimes 5 to 10 years within 200 metres of shelter sites. <sup>+</sup> |

NPWS 2000, <sup>+</sup> NPWS 1999 b

A review of fire management throughout NPWS has resulted in a modified approach to fire planning based on the level of complexity involved. Management of NPWS estate is in accordance with an adopted state-wide NPWS approach to fire management planning. This approach emphasises the protection of life and property, as well as providing a framework for protection of natural and cultural heritage values. It uses a system of zones for fire management in NPWS reserves. These zones are management areas where a specified fire management operational objective and strategy have been developed to mitigate against the threat of a wildfire. These zones are compatible with the system adopted by the Bushfire Coordinating Committee for use in District Bushfire Management Committee (DBFMC) bushfire risk management plans.

In regard to Chambigne and Koukandowie Nature Reserves, the NPWS considers that the reserves require separate fire management strategies be prepared. A separate, specific fire management strategy is in preparation and will be the reserves' primary fire management document. Annual hazard reduction programs are also submitted to the district Bush Fire Management Committee. However, the reserves will be managed under the provisions of four fire management zones:

1. Asset protection zone (APZ), managed to protect assets. Regimes of 1 to 3 years apply to this zone.
2. Strategic wildfire control zone (SWCZ), managed to improve effectiveness of existing control lines, to assist protection of adjacent assets or heritage areas and to prevent broad scale fire movement throughout the reserves. Regime of 3 to 8 years will apply within this zone.
3. Land (Heritage Area) management zone (HAMZ), managed to provide for the conservation requirements of species, communities and cultural heritage assets. Regimes as listed in tables 5 & 6 will be applied.
4. Special area management zone (SAMZ), managed to exclude fire from special features such as threatened plants or animals.

## Pest Plants

NPWS weed control activity within the reserves is conducted in accordance with the North Coast Region Pest Management Strategy (NPWS 2002d). This strategy has been developed for the region as a whole and identifies pest populations, priorities for control and control programs.

Limited weed issues have been recorded on the reserves, a reflection of the relatively undisturbed and inaccessible location of the reserves. Small, isolated patches of lantana (*Lantana camara*) grow on the plateaus of the reserves, with larger infestations growing in adjacent gullies and hillsides, predominantly on private property. Lantana is a vigorous invader of disturbed areas, often forming dense thickets. It competes with native plants and retards their growth by excreting allelopathic inhibitors into the soil. It alters habitat values and impedes access (NPWS 2002d).

Giant Parramatta grass (*Sporobolus fertilis*) and fireweed (*Senecio madagascariensis*), occur on lowland areas along pasture margins, primarily on private property. Giant Parramatta grass is vigorous, persistent and invasive of disturbed areas. Once established it can displace low native vegetation and provide a seed source for dispersal by cattle, pedestrians and vehicles (NPWS 2002d).

## Pest Animals

NPWS pest animal control activity within the reserves is also conducted in accordance with the North Coast Region Pest Management Strategy (refer to Pest Plants).

Vertebrate pests recorded on the reserves include red foxes (*Vulpes vulpes*), cattle (*Bos taurus*) and wild dogs (*Canis familiaris*). It is likely that feral cats (*Felis cattus*) live in and adjacent to the reserves. Feral cats have been observed on Perrenial Creek adjacent to Chambigne Nature Reserve east (Edwards pers. comm. 2004). European rabbits (*Oryctolagus cuniculus*) and brown hares (*Lepus capensis*) have been noted in small numbers on lowland areas along the margins of the reserves.

Cattle graze the perimeter of the reserves, mostly excluded by cliffs and the discontinuous sandstone escarpment. There are limited water and grazing opportunities within the reserves to attract cattle. During times of drought, cattle may move up into the lower slopes of the reserves seeking feed. Cattle are recognised as a potential threat to the reserves through soil disturbance and erosion, weed transfer, direct grazing and or trampling of threatened plants.

Foxes are seen regularly on some properties adjacent to the reserves. Foxes represent a significant threat to a range of mammal fauna within and adjacent to the reserve, particularly rufous bettong and brush-tailed rock-wallabies. Both foxes and dogs are known predators of rock wallabies (Eldridge & Close 1995), however foxes have a far greater potential impact due to their size, agility and ability to exploit a wider range of prey species.

Wild dogs / dingoes live in and around the reserves in small numbers, appear transitory and are seasonally active. To date, the genetic integrity of the dingoes in the area is undetermined. Stock deaths have occurred and baiting is undertaken annually adjacent to both reserves. The NPWS contributes financially to local wild dog associations, liaises with the Grafton Rural Lands Protection Board and supports individual neighbours with specific wild dog control.

### **Isolation and Fragmentation**

Clearing of vegetation within the bioregion has resulted in a high loss of biodiversity and fragmentation of habitat. Long term conservation of biodiversity depends upon the protection, enhancement and connection of remaining habitat across the landscape, involving vegetation remnants on both public and private lands. Nearby vegetated areas consolidate the habitat values of the reserve and provide ecological corridors to other surrounding forested areas.





#### 4. KOUKANDOWIE AND CHAMBIGNE NATURE RESERVES – MANAGEMENT ISSUES AND STRATEGIES.

| Current Situation  | Desired Outcomes   | Proposed Actions and Guidelines   | Priority                  |
|--|--|---|---------------------------|
| <p><b>Cultural Heritage</b></p> <p>The Clarence Valley is culturally highly significant with a diverse and rich history of land use by Aboriginal people. Koukandowie and Chambigne Nature Reserves lie within the traditional lands of the Gumbaynggir people, today represented by the Burraway Wadjard Elders and members of the Grafton Ngerrie Local Area Land Council.</p> <p>The area is known to contain many Aboriginal sites of national and regional importance (refer to Section 3.4). Two Aboriginal cultural heritage sites have been recorded on Koukandowie Nature Reserve with one additional site recorded directly adjacent to the reserve. One site has been recorded on Chambigne Nature Reserve and numerous sites on adjacent lands. Numerous sites are likely to occur within both reserves, and further survey work is required. It is important that the local Aboriginal community is involved in the protection of cultural values in the reserves.</p> <p>No known significant non-Aboriginal heritage sites occur within the reserves, although a number of significant items have been identified in surrounding areas (refer to section 3.4). Several contemporary non-Aboriginal features denoting prior European use of the reserve have been noted in the reserves including roads, trig stations and fences.</p> | <ul style="list-style-type: none"> <li>• Cultural heritage values are identified, conserved and threats managed appropriately.</li> <li>• Neighbours are aware of the cultural heritage significance of the reserves and surrounding areas.</li> <li>• Aboriginal heritage values are protected in partnership with local aboriginal communities.</li> </ul> | <ul style="list-style-type: none"> <li>• Survey the reserves to locate, identify and protect European and Aboriginal cultural heritage sites and significance.</li> <li>• Work with the Burraway Wadjard Elders and members of the Grafton Ngerrie Local Area Land Council to manage sites, places and values.</li> </ul> | <p>Medium</p> <p>High</p> |

| Current Situation   | Desired Outcomes   | Proposed Actions and Guidelines  | Priority                                  |
|---|--|--|---|
| <p><b>Catchment Management</b></p> <p>There are currently minimal soil erosion or water quality issues within the reserves. The reserves represent valuable catchment protection for a number of creeks which feed into major water supply rivers (refer to section 3.4).</p> <p>The soils within and surrounding the reserves are predominantly poor, highly erodible sandy soils. Management activities that may potentially generate erosion include fire events, and the creation and maintenance of access roads and fire control lines.</p> | <ul style="list-style-type: none"> <li>• There is no evidence of accelerated soil erosion in the reserves.</li> <li>• There is no reduction in the quality of water or the health of watercourses in the reserve.</li> </ul> | <ul style="list-style-type: none"> <li>• Soft fire control line options will be applied where possible ie slashing, mowing and prescribed burning under appropriate weather.</li> <li>• Fire trail construction and maintenance will apply best practice techniques in relation to slope, sediment trapping, placement and drainage.</li> <li>• NPWS contributions to trail maintenance on adjoining lands where these trails are used for management access will be conditional with standards listed above.</li> </ul> | <p>Medium</p> <p>Medium</p> <p>Medium</p> |

| Current Situation   | Desired Outcomes  | Proposed Actions and Guidelines  | Priority   |
|---|---|--|--|
| <p><b>Native Plants and Animals</b></p> <p>The reserves occur in a biogeographical overlap zone with a large diversity of plant and animal species.</p> <p>The reserves contain a number of threatened plant and animal species with additional threatened species predicted to occur within the reserves and on adjoining lands (refer to section 3.4).</p> <p>Limited information is available on the invertebrate and herpetofauna of the reserves.</p> <p>Localised threats to many species include inappropriate fire regimes, habitat segmentation, land clearing, recreational development and potential increases in fox numbers associated with wild dog / dingo removal.</p> <p>Ecological viability of the reserve would be improved by the maintenance of vegetation corridors on neighbouring lands. This would assist in the movement of wildlife between the reserve and other forested areas.</p> | <ul style="list-style-type: none"> <li>• The population status of threatened species is identified in terms of numbers, distribution and locations.</li> <li>• Threatened species populations are viable, healthy and continue in perpetuity.</li> <li>• Threatened species biology and ecology information base expanded.</li> <li>• Neighbours are aware and actively supportive of threatened species populations.</li> <li>• The ecological viability of the reserve is enhanced by retention of native vegetation in surrounding areas.</li> </ul> | <ul style="list-style-type: none"> <li>• Enhance information on threatened plant and animal populations and identify the range, distribution and abundance of these species within the reserves.</li> <li>• Apply appropriate fire regimes and other protective measures as they are identified for all threatened or significant species. (<i>refer to Fire management, Pest species &amp; Visitor access and use</i>)</li> <li>• Liaise with specialist botanists, zoologists and recovery plan coordinators regarding threatened or significant species.</li> <li>• Maintain confidentiality of sites of threatened or significant species.</li> <li>• Create awareness of threatened species among neighbours, including NCW, and the local community. Encourage neighbours to maintain threatened species populations and habitat on adjoining lands, including retention, and if possible expansion, of areas of native vegetation close to the reserves.</li> <li>• Actively encourage and assist with research projects into significant species.</li> </ul> | <p>Medium</p> <p>Medium</p> <p>Low</p> <p>Low</p> <p>High</p> <p>Low</p> |

| Current Situation   | Desired Outcomes  | Proposed Actions and Guidelines   | Priority  |
|---|---|---|---|
| <p><b>Fire</b></p> <p>Fire is the dominant management issue on both reserves with substantial areas of the reserves burnt annually.</p> <p>Historically, fire regimes have been driven by adjacent landholders applying fire regimes appropriate to their purposes (refer to Section 3.8).</p> <p>Fire regimes on the reserves, while providing some burn mosaic and fuel reduction benefits, remain unaccountable to the significant natural values of the reserves. Fires usually persist throughout entire individual sections of the nature reserves in a single event.</p> <p>Fire appears to be a significant factor in reduction in numbers and range of the <i>Grevillea beadleana</i> and the undescribed <i>Bertya sp. nova</i> populations within Chambigne Nature Reserve (refer to section 3.8, Fire). Intense fire regimes also threaten other endemic threatened species within the reserves, particularly <i>Eucalyptus tetrapleura</i>, <i>Angophora robur</i> and <i>Melichrus hirsutis</i> (NPWS 2002b).</p> <p>A specific fire management strategy, consistent with provisions of the Clarence Valley BFMC Risk Management Plan and Plan of Operations, is being prepared for the reserves as the primary fire management document.</p> | <ul style="list-style-type: none"> <li>• Life, property, natural and cultural values within and adjacent to the reserves are protected from bushfire.</li> <li>• Fire regimes are appropriate for the conservation and enhancement of native flora and fauna communities, particularly significant species.</li> <li>• Community aware, well-informed and supportive of NPWS fire objectives and operations.</li> <li>• Spread of wildfire onto and off the reserves is minimised.</li> </ul> | <ul style="list-style-type: none"> <li>• Continue development and maintenance of fire control line system around the reserves perimeter. Specifically establish control lines on north-eastern boundary of Chambigne east and north-eastern end of Koukandowie east.</li> <li>• Actively assist neighbours in prescribed burning activities adjacent to reserves.</li> <li>• Continue to experiment with various low impact control line options</li> <li>• Actively engage with neighbours and community individually and in community forums, as well as the Clarence Valley BFMC, to create awareness, cooperation and support of NPWS fire management objectives and activities within the reserves.</li> <li>• Manage relevant portions of the reserves under the NPWS zoning system (refer to Section 3.8) and reserve specific fire strategies.</li> </ul> | <p>High</p> <p>Medium</p> <p>Medium</p> <p>Medium</p> <p>High</p> |

| Current Situation  | Desired Outcomes | Proposed Actions and Guidelines  | Priority                  |
|--|------------------|--|---------------------------|
| <p>This plan of management and the separate fire management strategy are consistent with provisions of the Clarence Valley Bushfire Management Committee Bush Fire Risk Management Plan and the Bushfire Risk Management Plan of Operations.</p> |                  | <ul style="list-style-type: none"> <li>• Ensure fire regimes are appropriate for vegetation communities and significant species within specified zones of the reserves (refer to Section 3.8).</li> <li>• Obtain further information on fire ecology and appropriate fire regimes for <i>Grevillea beadleana</i> and <i>Bertya sp.nova</i>.</li> </ul> | <p>High</p> <p>Medium</p> |

| Current Situation   | Desired Outcomes  | Proposed Actions and Guidelines   | Priority   |
|---|---|---|--|
| <p><b>Pest Species</b></p> <p>NPWS pest plant and animal control activity within the reserves is pursuant to the North Coast Region Pest Management Strategy.</p> <p>Pest plants are a minor issue on the reserves due to the relatively undisturbed and inaccessible location. Isolated patches of lantana grow on the plateaux, with some Giant Parramatta grass and fireweed along pasture margins (refer to section 3.8).</p> <p>Pest animals recorded on the reserves include foxes, wild dogs, rabbits, hares and domestic cattle. Feral cats are likely to occur (refer to section 3.8).</p> <p>Small numbers of dingoes occur in and around the reserve (refer to section 3.8)</p> <p>NPWS liaises with the Grafton Rural Lands Protection Board (RLPB), wild dog associations and supports individual neighbours with specific wild dog control.</p> | <ul style="list-style-type: none"> <li>Impacts of pest plant and animal species on native species and neighbouring lands are minimised.</li> <li>A cooperative approach is applied to pest management with other agencies and community.</li> <li>Movement of pest populations into and out of NPWS estate is minimised.</li> <li>Pest species are controlled and, where possible, eradicated on reserves and adjacent lands.</li> <li>Control of introduced species has minimal impact on native species.</li> </ul> | <ul style="list-style-type: none"> <li>Monitor, control and, where possible, eradicate pest species, in accordance with the NPWS North Coast Region Pest Management Strategy. Control of foxes, wild dogs, cats will be a priority.</li> <li>Liaise with neighbours, the Grafton RLPB, Pristine Waters Shire Council and wild dog associations in implementing pest plant and animal control programs. In particular, this will include assisting: <ul style="list-style-type: none"> <li>neighbours to control weed species adjacent to the reserves and directly target individual dogs impacting on stock;</li> <li>neighbours and the RLPB in recording stock deaths and implementing targeted baiting programs.</li> </ul> </li> <li>Monitor to ensure cattle are not grazing significant plant species. Remove cattle from reserves and, where required, negotiate with neighbours to control further incursions into the reserves in accordance with NPWS Boundary Fencing policy.</li> <li>Continue opportunistic collection of wild dog / dingo DNA and scat samples.</li> </ul> | <p>High</p> <p>Medium</p> <p>Medium</p> <p>Low</p> |

| Current Situation  | Desired Outcomes   | Proposed Actions and Guidelines   | Priority  |
|--|--|---|---|
| <p><b>Visitor Access and Use</b></p> <p>The reserves are surrounded by private property except for public lands owned by NCW adjacent to Chambigne Nature Reserve. Consequently, access to the reserves is available only to direct neighbours and to the public indirectly only via NCW lands where visitor and interpretive facilities will be provided by NCW (refer to section 3.5).</p> <p>The reserves currently receive low levels of use for bushwalking and picnicking. Some visitors access the reserves through private property without consent. No visitor facilities exist on the reserves. Activities not consistent with the study of natural environments are considered inappropriate uses of a nature reserve.</p> <p>Promotion of understanding and appreciation of the conservation values of the reserve will be important for minimising damaging activities.</p> | <ul style="list-style-type: none"> <li>• Visitor use is ecologically sustainable and consistent with management objectives as a nature reserve.</li> <li>• Reserve visitors do not trespass on neighbouring private property.</li> <li>• The community is aware of the significance of the reserves and supports management programs.</li> </ul> | <ul style="list-style-type: none"> <li>• In the course of the development of the recreational facilities associated with the Shannon Creek dam, NPWS will negotiate with NCW to ensure:               <ul style="list-style-type: none"> <li>– NCW developments do not provide inappropriate public access to Chambigne Nature Reserve.</li> <li>– adequate buffers are established between visitor developments and Chambigne Nature Reserve.</li> <li>– impacts of Shannon Creek dam visitors are fully and effectively dealt with on NCW lands.</li> </ul> </li> <li>• No recreational opportunities or facilities will be developed on the reserves.</li> <li>• Neighbour contact details will not be provided to members of the public seeking access to the reserves.</li> <li>• Signs and gates will be used to assist neighbours in addressing trespass issues as required.</li> <li>• Reserve maps generated for public distribution will not display private access roads.</li> </ul> | <p>High</p> <p>Medium</p> <p>Medium</p> <p>Medium</p> <p>High</p> |



| Current Situation | Desired Outcomes | Proposed Actions and Guidelines   | Priority                 |
|-------------------|------------------|---|--------------------------|
|                   |                  | <ul style="list-style-type: none"> <li>• Domestic pets, camping, horse riding and trail bike riding will not be permitted within the reserves.</li> <li>• Contribute to the proposed interpretive facilities at the Shannon Creek dam to promote awareness of the Kangaroo sandstone belt and the associated reserve system.</li> </ul> | <p>Low</p> <p>Medium</p> |

| Current Situation  | Desired Outcomes  | Proposed Actions and Guidelines  | Priority   |
|--|---|--|--|
| <p><b>Management Operations</b></p> <p>There are no management facilities within the reserves, apart from the access trail within Chambigne Nature Reserve north (refer to section 3.6).</p> <p>The boundary alignment has a high boundary to reserve area ratio, and represents substantial edge effects. The alignment does not provide for animal species that utilise the reserve and adjacent valley floors (refer to section 3.7).</p> <p>In some areas the boundaries are indistinct. There are significant difficulties in managing cross boundary influences such as fire and stock (refer to section 3.8).</p> <p>Strong neighbour support is paramount in providing management access to the reserves, managing cross-boundary issues (refer to section 3.7).</p> | <ul style="list-style-type: none"> <li>• Management infrastructure remains low key and unobtrusive, consistent with the management principles for nature reserves, as well effective and appropriate for purpose.</li> <li>• Boundary alignment is consolidated where possible and edge effects on the reserves are minimised.</li> <li>• Sound neighbour and community relations and cooperation in management of cross boundary influences and other reserve projects are established and maintained</li> <li>• NPWS retains access to the reserves.</li> </ul> | <ul style="list-style-type: none"> <li>• NPWS will contribute to the maintenance of key reserve access roads and trails to an appropriate standard on a cost share basis with neighbours and local government.</li> <li>• The short section of the existing access through Chambigne north will be classed as a management trail and maintained in its current form.</li> <li>• Relevant neighbours will continue to have access along the management trail within Chambigne north.</li> <li>• Survey boundaries where required and erect low key NPWS signage to demarcate boundaries where appropriate.</li> <li>• Maintain good neighbour and community relations and continue to proactively meet with neighbours on an individual basis.</li> <li>• Recognise cross boundary influences and develop and implement management tools, as well as reserve related projects cooperatively with neighbours.</li> </ul> | <p>Medium</p> <p>Low</p> <p>High</p> <p>High</p> <p>High</p> |

| Current Situation  | Desired Outcomes   | Proposed Actions and Guidelines  | Priority  |
|--|--|--|---|
| <p>North Coast Water (NCW) is upgrading the water supply system utilising land adjacent to Chambigne Nature Reserve. The project involves construction of a range of structures and visitor facilities (refer to section 3.7).</p> | <ul style="list-style-type: none"> <li>• The Shannon Creek Dam project and associated facilities do not impinge upon reserve values.</li> <li>• NCW infrastructure and lands are managed in a manner complementary to Chambigne Nature Reserve.</li> </ul> | <ul style="list-style-type: none"> <li>• Continue to assess lands offered for sale adjacent to the reserves with potential to consolidate boundaries.</li> <li>• Promote appreciation of the reserves values among neighbours to encourage and facilitate complementary conservation of natural systems on adjoining lands.</li> <li>• Work with NCW in development and application of fire, pest and land management plans for NCW lands.</li> <li>• Monitor the construction phase of the dam for potential impacts on Chambigne Nature Reserve.</li> <li>• Work closely with NCW at an operational level particularly with proposed on ground NCW staff.</li> </ul> | <p>High</p> <p>Medium</p> <p>Low</p> <p>Low</p> <p>Medium</p> |

| Current Situation  | Desired Outcomes   | Proposed Actions and Guidelines   | Priority                          |
|--|--|---|-----------------------------------|
| <p><b>Non-NPWS Use</b></p> <p>Survey trigonometrical stations are located at the western end of Chambigne Nature Reserve north and at the northern end of Koukandowie Nature Reserve west, managed in accordance with an existing agreement with LPI (refer to section 3.6).</p> <p>No other non-NPWS use currently occurs in the reserve.</p> | <ul style="list-style-type: none"> <li>• Use and maintenance of the trigonometrical station occurs in accordance with formal agreements and does not impact upon Chambigne Nature Reserve.</li> <li>• Where possible, no additional non-NPWS use occurs in the reserve.</li> </ul> | <ul style="list-style-type: none"> <li>• Authorised access for use and maintenance of the trigonometrical stations and powerlines will be permitted under the provision of existing or future formal agreements between NPWS and LPI.</li> <li>• No new non-NPWS facilities will be permitted within the reserves, unless consistent with the NPW Act.</li> <li>• Ensure all non-NPWS uses are licensed as appropriate under the NPW Act, and proper commercial returns are obtained where possible.</li> </ul> | <p>Low</p> <p>High</p> <p>Low</p> |

| Current Situation   | Desired Outcomes   | Proposed Actions and Guidelines   | Priority                               |
|---|--|---|--|
| <b>Information Gaps and Research</b> <ul style="list-style-type: none"> <li>Various research projects and other information gathering efforts have been undertaken in and around the reserves (refer to Section 3.4, Non-Aboriginal heritage and Native plants).</li> <li>Further scientific study is needed to improve understanding of the natural heritage values of the reserves and adjoining lands and the processes that affect them.</li> </ul> | <ul style="list-style-type: none"> <li>Information on the reserves is comprehensive and complete.</li> <li>Management of the reserves is underpinned by sound information.</li> <li>Information provides a benchmark for effective monitoring of changes to reserve elements over time.</li> </ul> | <ul style="list-style-type: none"> <li>Continue incidental plant and fauna surveys and to gather information from neighbours.</li> <li>Encourage or undertake further research to improve knowledge and management of natural and cultural heritage (refer to <i>Native plant and animal conservation, Cultural heritage, Pest species and Fire management</i>).</li> <li>Identify research opportunities and their relevance to the reserves as they emerge, to guide research by external organisations.</li> </ul> | <p>Medium</p> <p>Medium</p> <p>Low</p> |

### Legend for Priorities

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

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

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

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