



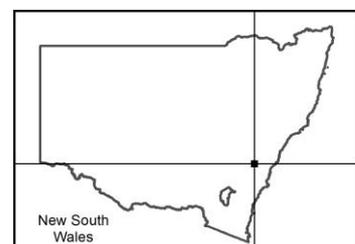
# Plan of Management

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## Joadja and Wollondilly River Nature Reserves



# Joadja and Wollondilly River Nature Reserves Plan of Management

**NSW National Parks and Wildlife Service**

**June 2013**

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**This plan of management was adopted by the Minister for the Environment on 16 June 2013**

## Acknowledgements

This plan of management is based on a draft plan prepared by staff of the Metropolitan South West Region of the NSW National Parks and Wildlife Service (NPWS), part of the Office of Environment and Heritage.

NPWS acknowledges that these reserves are in the traditional country of the Dharawal and Gundungurra people. For additional information or any inquiries about this park or this plan of management, contact the NPWS Mount Annan Office, Mount Annan Drive, Mount Annan NSW 2567 or by telephone on (02) 4634 7900.

**Front cover image:** Cascades Pool in the Wingecarribee River, Wollondilly River Nature Reserve. Photo: R Pedroza/NPWS.

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## Foreword

Joadja and Wollondilly River Nature Reserves cover 830 and 971 hectares respectively. Joadja Nature Reserve was established in 2001 and Wollondilly River Nature Reserve was established in 2002. Part of Joadja Nature Reserve and all of Wollondilly River Nature Reserve lie within the Warragamba Special Area which protects Sydney's drinking water supply.

Joadja and Wollondilly River Nature Reserves contain species of plants and animals associated with both the Sydney Basin Bioregion and the South Eastern Highlands Bioregion. One endangered ecological community, six threatened plant species and sixteen threatened animal species have been recorded within the reserves.

NSW *National Parks and Wildlife Act 1974* requires that a plan of management be prepared for each nature reserve. A plan of management can be prepared in combination with other contiguous or related reserves. A draft plan of management for Joadja and Wollondilly River Nature Reserves was placed on public exhibition from 10 December 2010 to 21 March 2011. The submissions received were carefully considered before adopting this plan.

The plan contains a number of actions to achieve the NSW 2021 goal to protect our natural environment, including undertaking works to maintain or improve water quality, implementing actions to help conserve threatened species, control of introduced plants and animals, and fire management. It also enhances recreation opportunities by providing for the development of a carpark and interpretive display along the Wombeyan Caves Road and development of a walking track within Joadja Nature Reserve.

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



**Robyn Parker MP**  
**Minister for the Environment**

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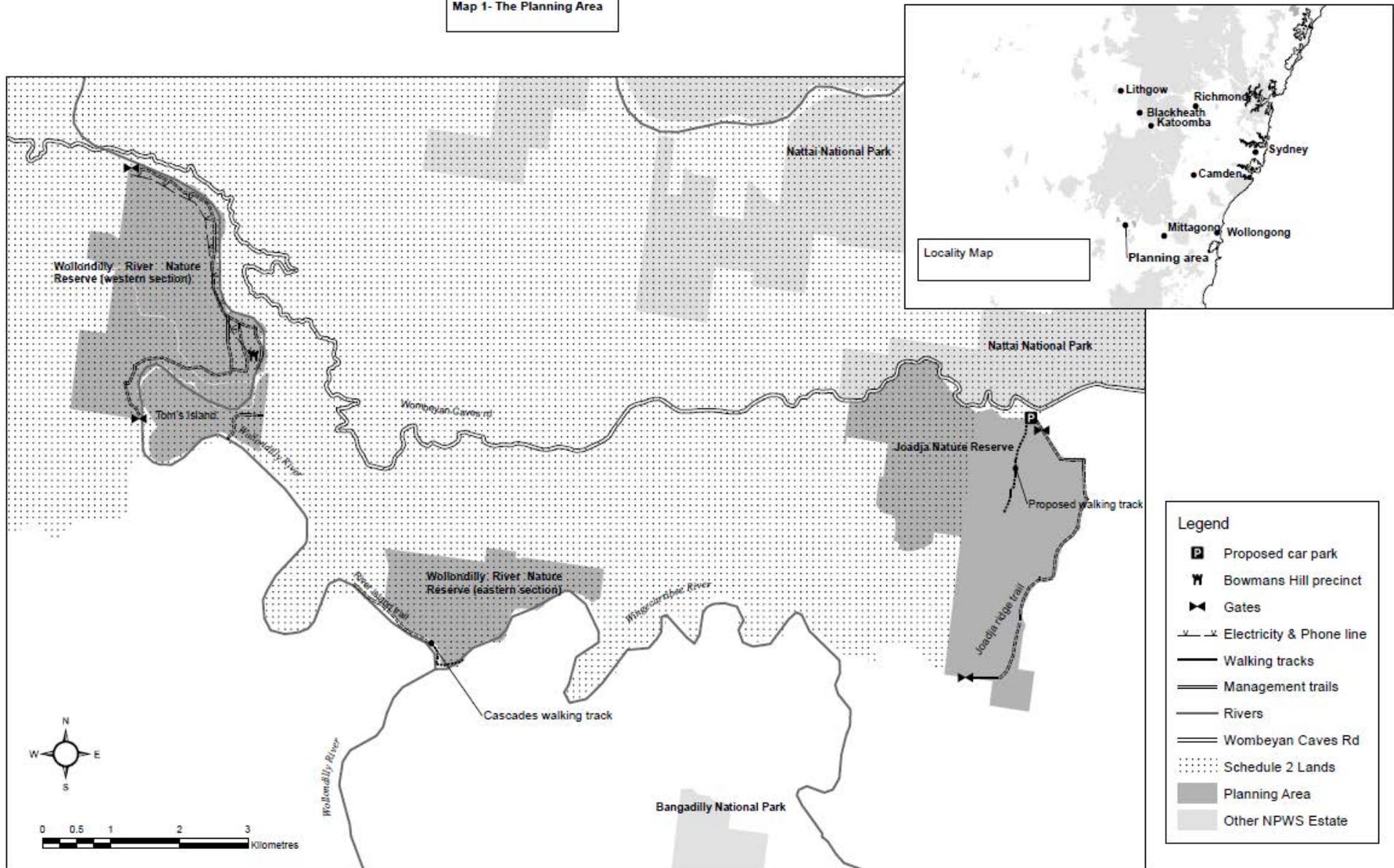
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# Map 1: Joadja Nature Reserve and Wollondilly River Nature Reserve

Map 1- The Planning Area



## **1. Location, gazettal and regional context**

Joadja and Wollondilly River Nature Reserves (the planning area) are located on the Southern Highlands of New South Wales approximately 30 kilometres north-west of Mittagong, via the Wombeyan Caves Road (see Map 1). Joadja Nature Reserve is 830 hectares in size and was reserved on 1 January 2001. Wollondilly River Nature Reserve is made up of two sections (the eastern and western sections) with a combined area of 971 hectares. Wollondilly River Nature Reserve was reserved on 28 June 2002, with an addition reserved on 13 August 2010.

Joadja Nature Reserve and the eastern section of Wollondilly River Nature Reserve were reserved as a result of the Southern Regional Forest Agreement (RFA).

The planning area lies to the south-west of Nattai National Park and north of Bangadilly National Park (see Map 1). Sections of vacant Crown land surround and connect the planning area. Investigations have been made towards acquiring further vacant crown land on the southern side of the Wollondilly River.

The planning area is located in the Wingecarribee Shire local government area and sections of the planning area fall within the Schedule 2 boundary of Warragamba Special Area. The planning area is located within the area of the Hawkesbury-Nepean Catchment Management Authority and the Pejar and Illawarra Local Aboriginal Land Councils.

## 2. Management context

### 2.1 Legislative and policy framework

The management of nature reserves in NSW is in the context of the legislative and policy framework, primarily the *National Parks and Wildlife Act 1974* (NPW Act), the National Parks and Wildlife Regulation, the *Threatened Species Conservation Act 1995* (TSC Act), *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the policies of the National Parks and Wildlife Service (NPWS).

Other legislation, international agreements and charters may also apply to management of the area. In particular, the *Environmental Planning and Assessment Act 1979* (EPA Act) may require the assessment and mitigation of the environmental impacts of works proposed in this plan.

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 Joadja and Wollondilly River Nature Reserves except in accordance with this plan. This plan will also apply to any future additions to these reserves. Should management strategies or works be proposed for these reserves or for any additions that are not consistent with this plan, an amendment to this plan or a new plan will be prepared and exhibited for public comment.

Part of Joadja Nature Reserve and all of Wollondilly River Nature Reserve are Schedule 2 lands within the Warragamba Special Area (see Map 1). Under the *Sydney Water Catchment Management Act 1998*, the purpose of special areas is to protect the quality of stored waters for drinking purposes and to maintain the ecological integrity of their catchments. The Warragamba Special Area protects drinking water supply by acting as a buffer zone to help stop nutrients and other substances that could affect the quality of water from entering Lake Burragorang, the main source of drinking water for Sydney. Human activity is restricted within the Special Area.

The State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 applies to the planning area, and requires public authorities to consider whether a proposed activity would have a neutral or beneficial effect on water quality prior to the carrying out of any activity to which part 5 of the EPA Act applies.

The Sydney Catchment Authority (SCA) and NPWS have signed a joint management agreement and prepared a Special Areas Strategic Plan of Management (SASPoM) (SCA 2007). The agreement and the SASPoM set out the responsibilities of the SCA and NPWS for the integrated management of the Warragamba Special Area. Within the Special Area, the NPWS is responsible for the management of lands reserved under the NPW Act while the SCA is responsible for the maintenance and protection of water quality.

### 2.2 Management purposes and principles

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

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

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

Nature reserves differ from national parks in that they do not have the provision of recreation as a management principle.

### **2.3 Statement of significance**

The planning area is of regional significance for its plant and animal communities. It contains species of plants and animals associated with both the Sydney Basin Bioregion and the South Eastern Highlands Bioregion.

The planning area protects part of the catchment of the Wollondilly and Wingecarribee rivers. These rivers flow into Lake Burragorang, which is the major drinking water supply for the city of Sydney.

### **2.4 Specific management directions**

Management of the planning area will focus on protection of its significant biological and catchment values. Major strategies to achieve these objectives will be:

- control and monitoring of introduced animals, particularly feral goats and pigs;
- rehabilitation of degraded areas, including the treatment and monitoring of serrated tussock and other agricultural weeds;
- control of erosion and point sources of pollution; and
- use of the planning area only for low impact activities, such as walking.

### **3. Values**

The location, landforms and plant and animal communities of an area have determined how it has been used and valued. Both Aboriginal and non-Aboriginal people place values on natural areas, including aesthetic, social, spiritual and recreational values. These values may be attached to the landscape as a whole or to individual components, for example to plant and animal species used by Aboriginal people. This plan of management aims to conserve both natural and cultural values. For reasons of clarity and document usefulness, various aspects of natural heritage, cultural heritage, threats and on-going use are dealt with individually, but their interrelationships are recognised.

#### **3.1 Geology, landscape and hydrology**

The planning area lies within the catchment of the Wollondilly and Wingecarribee Rivers, which is part of the catchment for Lake Burragorang. Drainage from Joadja Nature Reserve flows into the Wingecarribee River. The eastern section of Wollondilly River Nature Reserve is located at the junction of the Wingecarribee and Wollondilly Rivers and the western section of Wollondilly River Nature Reserve is located on the foreshore of the Wollondilly River.

The topography of the planning area consists of areas of plateau and ridges that drop steeply into deep, narrow valleys. There are cliff lines, scree slopes and rocky outcrops around the upper parts of the valleys. Elevation is between 550 metres and 790 metres above sea level (Mills & Associates 2002a and DEC 2004). Many slopes within the planning area are steep, with inclines of over 50 degrees. The lower slopes of Wollondilly River Nature Reserve consist of relatively flat alluvial soils.

Dramatic views are available from the ridges within the planning area. The cliff lines, rock outcrops and tall forests on the valley floors are attractive features.

Ridge tops and upper slopes of Joadja Nature Reserve comprise Hawkesbury Sandstone, underlain by softer units of the Illawarra Coal Measures and Berry Siltstone exposed on the slopes (Mills & Associates 2002a). The lower slopes and valley floors consist of Silurian and Ordovician slate, phyllite and quartzite (Mills & Associates 2002a). Wollondilly River Nature Reserve is comprised almost entirely from Bindook porphyry, an igneous rock formed during the Upper Devonian age (DEC 2004). This is granite-like in appearance and erodes to form a clay-loam soil. These soils are highly erodible and result in significant instability on the steeper slopes where landslips and scree slopes are common (DEC 2004).

Erosion from trails and land slips in steeper parts of the planning area has the potential to cause water pollution.

#### **3.2 Native plants and animals**

The planning area is at the boundary of two bioregions. To the east is the Sydney Basin Bioregion, characterised by sandstone landscapes of Triassic and Permian age. To the west is the South Eastern Highlands Bioregion which covers an extensive area of the Central Tablelands and slopes of New South Wales and Victoria and is dominated by older rocks of Devonian and Silurian age (Thackway and Creswell 1995). The intersection of the two bioregions means that the planning area is high in biodiversity and contains species at their geographical limit.

Along with Bangadilly National Park, state forest, Crown lands and private lands, the planning area is part of a major habitat corridor of naturally vegetated lands stretching from Morton National Park in the south to Nattai and Blue Mountains National Parks in the north.

Maintenance of natural vegetation on private lands within the corridor is vital to maintaining the value of these lands.

Joadja Nature Reserve contains 7 native vegetation communities (Mills 2002a) and Wollondilly River Nature Reserve contains 6 native vegetation communities (NPWS 2003). Both reserves also contain areas of cleared, modified and regenerating vegetation. The vegetation communities are summarised in Table 1.

The Yellow Box 'Forest / Woodland' is a part of the complex of communities falling within the classification of the White Box — Yellow Box — Blakely's Red Gum Woodland community. This is classified as an endangered ecological community under the TSC Act and a critically endangered ecological community under the EPBC Act. Much of this community has been cleared across the State and it is poorly represented within conservation reserves.

**Table 1. Vegetation communities recorded in the planning area**

<b>Vegetation community</b>	<b>Location and status</b>
<i>Joadja Nature Reserve. Source: Mills (2002a)</i>	
Manna Gum Tall Forest	A small stand occurs on deep alluvial soils on floodplain in the south western part of the reserve.
River Peppermint Tall Forest	Extensive on slopes with moister aspects, gullies and deeper valleys.
Grey Gum – Stringybark Forest	Extensive on plateau areas and dry valley slopes. Open or shrubby understorey.
Sydney Peppermint Forest	Occurs on sheltered upper slopes and deep soils on plateau in southern part of reserve.
Yellow Box 'Forest/Woodland'	Occurs in small areas on lower slopes, on older rocks. Listed as an endangered ecological community under TSC Act and a critically endangered ecological community under EPBC Act.
Scribbly Gum – Stringybark 'Forest/Woodland'	Mainly found on exposed and rocky sites on plateaux and ridges.
Calytrix Heathland	Small patches are found on exposed sandstone surfaces on ridges and plateaux.
<i>Wollondilly River Nature Reserve. Source: NPWS (2003)</i>	
Devonian Red Gum – Yellow Box Woodland	Widespread in both sections of the reserve. Occurring on steep slopes.
Devonian Red Gum – Grey Box Woodland	Both sections of the reserve, on the lower slopes.
Grey Myrtle Dry Rainforest	Eastern section of the reserve. Occurs in some of the steeper gully lines and on scree slopes.
Highland Slopes Grey Gum – Stringybark Forest	Found at the higher elevations in both sections of the reserve.
Sheltered Porphyry Forest	Found in both sections of the reserve. Develops in some of the steeper gully lines, particularly in the eastern section of the reserve.
Tablelands River Oak Forest	The most common community bordering the Wollondilly and Wingecarribee Rivers, in both sections of the reserve.

Sixteen animal species and six plant species listed under the TSC Act have been recorded within the planning area. Of these species, two animal and three plant species are also listed as

threatened species under the EPBC Act. Threatened and significant species are summarised in Table 2.

The planning area has a high diversity of birds for a relatively small reserved area (DEC 2004, Mills & Associates 2002b). This includes eight species listed as threatened under the TSC Act. Many of the species present are uncommon within the South Eastern Highlands Bioregion. The high diversity in bird species is most likely due to the overlap between the South Eastern Highlands Bioregion and the Sydney Basin Bioregion.

Whilst no evidence of brush-tailed rock-wallabies has been found within the planning area, there are anecdotal records of possible sightings west of Wollondilly River Nature Reserve.

Under the TSC Act, recovery plans may be prepared to identify actions and priorities for threatened species, populations or ecological communities. Additionally, a threatened species Priorities Action Statement has been prepared which outlines broad strategies and detailed priority actions to promote the recovery of threatened species, populations and endangered ecological communities and to manage key threatening processes. Recovery plans have been prepared for the powerful owl, koala and yellow-bellied glider and the Priorities Action Statement includes detailed actions for all species listed in Table 2 except the narrow-leaved mallee ash.

**Table 2. Threatened and significant animal and plant species recorded in the planning area**

Common name	Scientific Name	Status
<b>Animals</b>		
Regent honeyeater	<i>Anthochaera phrygia</i>	Endangered*, Endangered#
Gang gang cockatoo	<i>Callocephalon fimbriatum</i>	Vulnerable*
Glossy black-cockatoo	<i>Calyptorhynchus lathami</i>	Vulnerable*
Brown treecreeper	<i>Climacteris picumnus victoriae</i>	Vulnerable*
Hooded robin	<i>Melanodryas cucullata cucullata</i>	Vulnerable*
Powerful owl	<i>Ninox strenua</i>	Vulnerable*
Speckled warbler	<i>Pyrrholaemus saggitatus</i>	Vulnerable*
Diamond firetail	<i>Stagonopleura guttata</i>	Vulnerable*
Large-eared pied bat	<i>Chalinolobus dwyeri</i>	Vulnerable*
Spotted-tailed quoll	<i>Dasyurus maculates</i>	Vulnerable*, Endangered#
Eastern false pipistrelle	<i>Falsistrellus tasmaniensis</i>	Vulnerable*
Eastern bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	Vulnerable*
Eastern freetailed-bat	<i>Mormopterus norfolkensis</i>	Vulnerable*
Yellow-bellied glider	<i>Petaurus australis</i>	Vulnerable*
Squirrel glider	<i>Petaurus norfolcensis</i>	Vulnerable*
Koala	<i>Phascolarctos cinereus</i>	Vulnerable*

Common name	Scientific Name	Status
<b>Plants</b>		
Bynoe's wattle	<i>Acacia bynoeana</i>	Endangered*, Vulnerable#
-	<i>Asterolasia buxifolia</i>	Endangered*
Narrow-leaved mallee ash	<i>Eucalyptus apiculata</i>	ROTAP
Camden woollybutt	<i>Eucalyptus macarthurii</i>	Vulnerable*
Cabbage kunzea	<i>Kunzea cabbagei</i>	Vulnerable*, Vulnerable#
Dwarf phyllota	<i>Phyllota humifusa</i>	Vulnerable*, Vulnerable#
-	<i>Solanum armourense</i>	Endangered*

\*Denotes status under TSC Act - Vulnerable or Endangered

#Denotes status under the EPBC Act - Vulnerable or Endangered

'ROTAP' Denotes species listed as a Rare or Threatened Australian Plant (ROTAP) according to Briggs and Leigh (1996)

### 3.3 Aboriginal heritage

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

The planning area lies within the country of the Dharawal and Gundungurra Aboriginal people, which extends from Lithgow to Goulburn. Other groups have associations with the area; the Daruk to the north, and Wiradjuri to the west. Today Joadja Nature Reserve and the eastern section of Wollondilly River Nature Reserve are within the area of the Illawarra Local Aboriginal Land Council and the Wodi Wodi Elders; and the western section of Wollondilly River Nature Reserve is within the area of the Pejar Local Aboriginal Land Council.

Although little is known about past Aboriginal association with the area, scarred trees, axe grinding grooves and artefact scatters have been recorded in the vicinity of the planning area. There are also stories that the hollows found at the junction of the Wollondilly and Wingecarribee Rivers were gouged by Gurangatch, a giant eel-like creature that was involved in the creation of the Wollondilly and Wingecarribee Rivers, during the dreaming (Mathews 1908). The open river flats are evidence of the land management practices, creating open grasslands in the uplands and close to the rivers as hunting grounds for game (Rose Deco Planning & Design 2003). These stories make the planning area important to Aboriginal communities today.

### 3.4 Historic heritage

The Wingecarribee district was first explored by Europeans in 1798, with settlement of the area commencing in 1815 (NSW Heritage Office 2006). Early settlers in the area undertook farming and grazing, with mining of shale oil commencing during the 1870s (Knapman 1988).

The Bowmans Hill precinct, within the western section of Wollondilly River Nature Reserve, contains a homestead, associated buildings, sheep yards and various sheds, rural artefacts and gardens which reflect farming and grazing practices in the area from the 1850s to 1980s.

The main homestead, known as 'Hartley House', is 'a locally rare example of post WWII housing, constructed in materials modern for the time and finely detailed by immigrant labour'.

The sheep yards provide 'a good example of vernacular building techniques applied to small-scale farming operation' (Rose Deco Planning & Design 2003).

Within the eastern section of Wollondilly River Nature Reserve there is also evidence of past rural farming practices in the area known as 'The Junction' at the intersection of the Wollondilly and Wingecarribee Rivers. This site contains remnants of an old stockyard and fencing associated with a previous Crown grazing lease.

Joadja Nature Reserve has a strong historical link with the former Joadja shale mining area immediately south-east of the reserve and the associated treatment works and township to the south (Knapman 1988). Some of the mines extended under the reserve. It is likely that holes associated with mining are still present in the planning area. The Joadja Ridge Trail was the first route used to transport shale oil from Joadja to Mittagong via Wombeyan Caves Road. The trail was also used by early settlers to access nearby services at High Range and Wangenderry. There is, however, no known physical evidence of the historic nature of the trail.

### **3.5 Visitor use, education and research**

The planning area provides opportunities for low-key nature appreciation activities including bushwalking, kayaking, swimming and fishing. The Cascades walking track is located within the eastern section of Wollondilly River Nature Reserve (see Map 1) and provides access to a waterfall. Within the rest of the planning area, management trails provide access for walkers.

Both sections of Wollondilly River Nature Reserve are adjacent to off-park accommodation facilities. A nudist resort is located adjacent to the eastern section and a camping area is adjacent to the western section. The majority of visitors to Wollondilly River Nature Reserve originate from these two sources.

## 4. Issues

### 4.1 Weeds and pest animals

The NSW Invasive Species Plan (DPI 2008) provides a State level framework for the coordinated and cooperative management of invasive species across tenure, aiming to build the capacity to prevent new incursions, contain existing populations and adaptively manage already widespread species in NSW.

NPWS exercises its responsibilities under the Invasive Species Plan via the preparation and implementation of Regional Pest Management Strategies. These strategies describe the local circumstances within each NPWS Region and contain a schedule of prioritised pest management programs for the reserves in each Region. These regional pest management programs are regularly reviewed and an annual program of pest management works is identified and implemented for each NPWS reserve.

A range of weed species have been recorded in the planning area. Common weed species found include serrated tussock (*Nassella trichotoma*), blackberry (*Rubus fruticosus*), prickly pear (*Opuntia stricta*), moth vine (*Araujia sericifera*) and tree of heaven (*Ailanthus altissima*) (DECC 2008). A suite of agricultural weed species, including sweet briar (*Rosa rubiginosa*), St John's wort (*Hypericum perforatum*), khaki weed (*Alternanthera pungens*), stinking roger (*Tagetes minuta*), scotch thistle (*Onopordum acanthium*), fire weed (*Senecio madagascariensis*), castor oil plant (*Ricinus communis*) and Paterson's curse (*Echium plantagineum*), occur in areas where past disturbance has occurred, particularly along management trails and the river flat areas of the western section of Wollondilly River Nature Reserve (DECC 2008). A plantation of paulownia trees (*Paulownia fortunei*) was established in the Bowmans Hill precinct by previous land owners.

Feral animal species that have been recorded within the planning area include the pig (*Sus scrofa*), goat (*Capra hircus*), cat (*Felis catus*), European red fox (*Vulpes vulpes*), rabbit (*Oryctolagus cuniculus*) and wild dog (*Canis familiaris*) (DECC 2008). Cattle, sheep and horses from adjacent agricultural areas occasionally stray into the planning area.

Invasion and establishment of exotic vines and scramblers; invasion of native plant communities by perennial grasses; predation by the European red fox; competition and habitat alteration from feral goats; and predation, habitat degradation, competition and disease transmission by feral pigs have been listed as key threatening processes under the TSC Act.

The control of all weed and pest species within the planning area will be undertaken in accordance with the Metropolitan South West Regional Pest Management Strategy (OEH 2012 in prep).

### 4.2 Fire

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

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

Very little information is available on the fire history of the planning area but it appears that fires have been infrequent. A large wildfire to the east in 2002 affected the far south-eastern corner of Joadja Nature Reserve. The last known wildfire in Wollondilly River Nature Reserve was in 1979 and included Tallygang Mountain. Recently, prescribed burns have been undertaken in Joadja

Nature Reserve and on the cleared river flats of the western section of Wollondilly River Nature Reserve as a tool to encourage regeneration.

Two (map-based) fire management strategies have been prepared for the planning area, one for Joadja Nature Reserve (DECC 2009a) and one for Wollondilly River Nature Reserve (DECC 2009b). The fire management strategies outline the recent fire history of the area, key assets within and adjoining the area including sites of natural and cultural heritage value, fire management zones which may include asset protection zones, and fire control advantages such as management trails and water supply points. The strategies also provide fire regime guidelines for conservation of vegetation communities and define fire management zones for which specific fire management objectives and strategies have been developed.

The fire management zones in the planning area include an Asset Protection Zone (APZ) at Bowman's Hill in Wollondilly River Nature Reserve. The purpose of an APZ is to protect human life, property and highly valued public assets and values. A program of APZ maintenance will be implemented to manage fire fuels (any material such as grass, bark, leaf litter and living vegetation which can be ignited and sustains a fire) so they do not exceed the levels prescribed by the NPWS Fire Management Manual. A Strategic Fire Advantage Zone (SFAZ) has been defined on the eastern side of Joadja Nature Reserve. SFAZs provide areas of fire protection advantage which will reduce the speed and intensity of bushfires, and reduce the potential for spot fire development. SFAZs also aid containment of bushfires to existing management boundaries. The management of SFAZs aims to achieve a mosaic fuel reduction pattern, where fire fuels for the majority of the zone are below the prescribed level. The remainder of the planning area is designated a Land Management Zone (LMZ) where the primary aim is to manage bushfires to meet the conservation objectives for species, populations, habitats, or cultural heritage values which may be at risk of long-term damage as a result of inappropriate fire regimes.

In accordance with the fire management strategies, an annual program of bushfire management and hazard reduction works will be identified and undertaken in the planning area if required. These works may include fire trail maintenance, mechanical hazard reduction such as mowing and slashing, and prescribed burns to reduce fuel hazards in APZs and SFAZs. Where operationally required, fire may also be introduced to Land Management Zones to meet management objectives. Hazard reduction programs, ecological burning proposals and fire trail works are submitted annually to the Wingecarribee Bush Fire Management Committee.

### **4.3 Isolation and fragmentation**

The planning area is part of an important habitat corridor that extends from Morton National Park in the south-east through to the Blue Mountains National Park in the north-west (see Section 3.2). The northern boundary of Joadja Nature Reserve adjoins the forested lands of Nattai National Park, and to the west of the planning area (adjacent to Wollondilly River Nature Reserve) there are forested lands of various tenure. Otherwise the areas surrounding the planning area have been extensively cleared resulting in fragmentation of habitat in the region and a high loss of biodiversity (DEC 2004). Long term conservation of biodiversity depends on the protection, enhancement and connection of remaining habitat across the landscape, incorporating vegetation remnants on both public and private lands. Vegetated areas adjacent to the planning area contribute to its habitat values and contribute to habitat corridors in the region. Maintaining the integrity of the remaining native habitat within the planning area and, where possible, linking this to other vegetated areas to facilitate wildlife corridors is important in ensuring the maintenance of biodiversity in the region.

#### **4.4 Climate change**

Climate change has been listed as a key threatening process under the TSC Act. Projections of future changes in climate for NSW include higher temperatures, increasing sea levels and water temperatures, elevated CO<sub>2</sub>, more intense but possibly reduced annual average rainfall, increased temperature extremes and higher evaporative demand. These changes are likely to lead to greater intensity and frequency of fires, more severe droughts, reduced river runoff and water availability, regional flooding, increased erosion and ocean acidification.

Climate change may significantly affect biodiversity by changing population size and distribution of species, modifying species composition, and altering the geographical extent of habitats and ecosystems. The potential impact of climate change is difficult to assess since it depends on the compounding effects of other pressures, particularly barriers to migration and pressure from feral animals. Species most at risk are those unable to migrate or adapt, particularly those with small population sizes or with slow growth rates.

Programs to reduce the pressures arising from other threats, such as habitat fragmentation, invasive species, bushfires, pollution and urban expansion, will help reduce the severity of the effects of climate change.

## 5. References

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## 6. Implementation

Current situation	Desired outcomes	Management response	Priority
<p><b>6.1 On-park ecological conservation</b></p> <p>The planning area is important in maintaining water quality in the Wollondilly River system. Part of the planning area is jointly managed with the Sydney Catchment Authority under the Special Areas Strategic Plan of Management to protect water quality flowing into Lake Burragorang.</p> <p>The steep slopes and soil types within the planning area are highly susceptible to erosion.</p> <p>The planning area contains several significant plant communities and species. These are in good condition and generally not threatened as long as fire regimes are appropriate (refer Section 6.6). A number of threatened animal species have also been recorded. Other threatened species, including the brush-tailed rock-wallaby, may also be present.</p> <p>With the exception of the northern boundary of Joadja Nature Reserve, the planning area consists of three small islands of protected land surrounded by other land uses.</p>	<p>Landscape and catchment values are protected.</p> <p>Soil erosion is minimised and water quality is maintained or improved.</p> <p>Native plant and animal species and communities are conserved.</p> <p>Negative impacts on threatened species and communities are stable or diminishing.</p>	<p>6.1.1 Undertake all works, including trail works and weed control, in a manner that minimises erosion and water pollution.</p> <p>6.1.2 Stabilise and rehabilitate any eroding areas that present a water quality risk.</p> <p>6.1.2 Monitor trails within the planning area for evidence of soil erosion and take remedial action as required.</p> <p>6.1.3 Implement relevant actions in recovery plans and the Priorities Action Statement for threatened species and communities present in the planning area.</p> <p>6.1.4 Undertake surveys for additional threatened animal and plant species, in particular the brush-tailed rock-wallaby.</p> <p>6.1.5 Seek the addition of suitable and available land adjacent to the planning area to improve the connectivity between the reserves and other reserves in the region.</p> <p>6.1.6 Liaise with neighbours to encourage conservation of wildlife and native vegetation in the vicinity of the planning area.</p>	<p>Ongoing/High</p> <p>High</p> <p>Medium</p> <p>High</p> <p>Low</p> <p>High</p> <p>Medium</p>
<p><b>6.2 Aboriginal heritage</b></p> <p>A number of Aboriginal sites have been recorded in the planning area and it is likely that more may occur given the number and variety of sites recorded on adjacent lands.</p>	<p>Aboriginal places and values are identified and protected.</p>	<p>6.2.1 Undertake Aboriginal site surveys in the planning area in conjunction with relevant Aboriginal community organisations.</p>	<p>Medium</p>

Current situation	Desired outcomes	Management response	Priority
<p>Aboriginal sites are potentially at risk from management activities such as use of heavy machinery for fire suppression. It would therefore be desirable to conduct surveys to improve understanding of the type and distribution of any Aboriginal features in the planning area.</p>	<p>Aboriginal people are involved in management of the Aboriginal cultural values of the park.</p> <p>Negative impacts on Aboriginal and historic heritage values are stable or diminishing.</p> <p>Understanding of the cultural values of the park is improved.</p>	<p>6.2.2 Consult and involve relevant groups and individuals in all aspects of management of Aboriginal sites, places and values within the planning area.</p> <p>6.2.3 Undertake an archaeological survey and cultural assessment prior to all works with the potential to impact on Aboriginal sites and places.</p> <p>6.2.4 Encourage further research into the Aboriginal heritage values of the park with the Illawarra Local Aboriginal Land Council, Pejar Local Aboriginal Land Council and other relevant groups and individuals.</p>	<p>Ongoing/High</p> <p>High</p> <p>Medium</p>
<p><b>6.3 .Historic heritage</b></p> <p>The Bowmans Hill precinct is of local heritage significance. The heritage assessment for this precinct recommends the retention of all buildings and structures with heritage significance. It also identifies the removal of a small block cottage which was more recently constructed.</p> <p>The buildings and assets in the precinct were transferred to NPWS from the SCA in 2009.</p> <p>Within the eastern section of Wollondilly River Nature Reserve there is also evidence of past rural farming practices in the area known as "The Junction".</p> <p>The Joadja Ridge Trail is of historical significance because of its former use as a transport route between the Joadja shale works and Mittagong. There are no known historic features along the trail but it should be surveyed and assessed to guide maintenance and other works.</p>	<p>Cultural features are conserved and managed in accordance with their significance.</p> <p>All culturally significant sites or objects will be recorded.</p>	<p>6.3.1 Record historic sites, assess for heritage value and leave in situ. Buildings required for management purposes will be maintained. Any buildings or cultural plantings that pose an unacceptable environmental or safety risk will be removed.</p> <p>6.3.2 Undertake an archaeological survey and cultural assessment prior to all works with the potential to impact on historic sites and places.</p> <p>6.3.3 Undertake a survey and assessment of the Joadja Ridge Trail and its historical links to the Joadja Ruins. Consult and involve interested stakeholders including the Berrima Historical Society and the owners of the Joadja Ruins.</p>	<p>Ongoing/High</p> <p>Low</p> <p>High</p>

Current situation	Desired outcomes	Management response	Priority
<p><b>6.4 Visitor use and services</b></p> <p>Access to Wollondilly River Nature Reserve is through Crown road reserves via Wombeyan Caves Rd. Entry to Joadja Nature Reserve is via Wombeyan Caves Road.</p> <p>A dormant management trail within Joadja Nature Reserve provides access and could potentially be converted to a walking track (see Map 1).</p> <p>The main visitor uses in the planning area are bushwalking, kayaking, swimming, and fishing. There is also a significant problem of illegal hunting activity occurring within the western section of Wollondilly River Nature Reserve, and 4WD and trail bike use in Joadja Nature Reserve.</p> <p>Use of the planning area must be carefully managed due to its relatively small and significant area of remnant vegetation as well as its water catchment values.</p> <p>Under the Sydney Water Catchment Management (General) Regulation 2008, cycling, horse riding and the driving of vehicles are prohibited within the sections of the planning area that are Special Area.</p>	<p>Visitor use is ecologically sustainable and appropriate to the reserve classification.</p> <p>Negative impacts of visitors on park values are stable or diminishing.</p>	<p>6.4.1 Prohibit recreational camping, horse riding, vehicle use and cycling within the planning area.</p> <p>6.4.2 Permit bushwalking within the planning area.</p> <p>6.4.3 Monitor the level and impact of visitor use in the planning area.</p> <p>6.4.4 Interpret the values of the Cascades walk and Bowmans Hill precinct.</p> <p>6.4.5 Negotiate with TransGrid to prevent public vehicle access to Joadja Nature Reserve.</p> <p>6.4.6 Negotiate with Wingecarribee Shire Council to formalise the existing car parking area on Wombeyan Caves Road. Provide an interpretive display and minimal impact use information at the parking area.</p> <p>6.4.7 Develop a walking track on the dormant management trail in Joadja Nature Reserve.</p>	<p>Ongoing/High</p> <p>Ongoing/Medium</p> <p>Low</p> <p>Low</p> <p>Medium</p> <p>Medium</p> <p>Low</p>

Current situation	Desired outcomes	Management response	Priority
<p><b>6.5 Weeds and pest animals</b></p> <p>The vegetation within Joadja Nature Reserve is relatively intact and therefore weed free.</p> <p>A number of weed species occur within Wollondilly River Nature Reserve. In particular, the cleared lands in the Bowmans Hill precinct contain extensive infestations of serrated tussock and other weeds associated with agriculture. Other weeds occurring within the reserve include moth vine and tree of heaven.</p> <p>Several introduced animals have been identified in the planning area, including goats, pigs, cats, dogs, foxes and rabbits. Domestic cattle, sheep and horses have also been observed in Wollondilly River Nature Reserve.</p> <p>The planning area is included in the Southern Highlands Wild Dog Control Plan (SHWDWG 2007). This plan identifies strategies to both minimise livestock losses and conserve dingos within the adjacent Nattai National Park.</p> <p>Due to the small size of the three sections of the planning area, it is not possible to control weeds and pest species in isolation. Cooperative programs with neighbouring landholders need to be undertaken.</p>	<p>Introduced plants and animals are controlled and where possible eliminated.</p> <p>Negative impacts of weeds on park values are stable or diminishing.</p> <p>Negative impacts of pest animals on park values are stable or diminishing.</p> <p>Programs are undertaken cooperatively with neighbours.</p>	<p>6.5.1 Manage introduced species in accordance with the Metropolitan South West Regional Pest Management Strategy and the Pest and Weed Management Operational Plan – Warragamba and Blue Mountains Special Areas. Priority will be given to protecting significant and threatened species and communities, new and emerging pest populations with a risk of spreading, and areas with good potential for recovery. In particular, regeneration techniques such as the use of fire will be trialled in the Bowmans Hill precinct.</p> <p>6.5.2 Seek the cooperation of neighbours in implementing weed and pest control programs.</p> <p>6.5.3 Encourage construction and maintenance of boundary fences to exclude stock from the planning area. Fencing assistance may be provided in accordance with NPWS policy.</p> <p>6.5.4 Implement the Southern Highlands Wild Dog Control Plan within the planning area.</p> <p>6.5.5 Conduct annual reviews of the prioritised pest programs identified in the Regional Pest Management Strategy and develop and implement an annual pest control program for the planning area.</p>	<p>High</p> <p>Ongoing/High</p> <p>Medium</p> <p>High</p> <p>Ongoing/High</p>

Current situation	Desired outcomes	Management response	Priority
<p><b>6.6 Fire management</b></p> <p>The occurrence of wildfires within the planning area appears to have been infrequent. A large wildfire affected the south- eastern corner of Joadja Nature Reserve in 2002 and the last known wildfire in Wollondilly River Nature Reserve was in 1979. Recently, prescribed burns have been undertaken in Joadja Nature Reserve and on the cleared flats in the western section of Wollondilly River Nature Reserve.</p> <p>Two (map-based) fire management strategies have been prepared for the planning area, one for Joadja Nature Reserve (DECC 2009a) and one for Wollondilly River Nature Reserve (DECC 2009b). The two fire management strategies set out appropriate fire frequencies for the vegetation communities and provides for protection of neighbouring assets and the buildings in the Bowmans Hill precinct.</p>	<p>Life, property and natural and cultural values are protected from fire.</p> <p>Fire regimes are appropriate for conservation of native plant and animal communities and the maintenance of water quality.</p> <p>Negative impacts of fire on natural and cultural heritage values are stable or diminishing.</p>	<p>6.6.1 Implement the fire management strategies for Wollondilly River Nature Reserve and Joadja Nature Reserve.</p> <p>6.6.2 Use prescribed fire if needed to achieve a variety of fire regimes in appropriate vegetation types, encourage regeneration, maintain habitat suitable for species with specific requirements and minimise the effect of fire on water quality.</p> <p>6.6.3 Continue to participate in the Wingecarribee District Bush Fire Management Committee and maintain coordination and cooperation with Rural Fire Service brigades, RFS fire control officers and neighbours with regard to fuel management and fire suppression.</p> <p>6.6.4 Suppress all unplanned fires in the planning area as quickly as possible.</p> <p>6.6.5 Encourage research into the ecological effects of fire in the planning area, particularly appropriate fire regimes for threatened species.</p> <p>6.6.6 Avoid construction of temporary trails (and slashing along existing trails) in areas of threatened and rare plants and where Aboriginal or historic heritage items are recorded or are potentially located.</p>	<p>High</p> <p>High</p> <p>Ongoing/High</p> <p>High</p> <p>Low</p> <p>Ongoing/High</p>

Current situation	Desired outcomes	Management response	Priority
<p><b>6.7 Infrastructure and maintenance</b></p> <p>The buildings within the Bowmans Hill precinct are currently used for management purposes, including accommodation while undertaking management operations within the Wollondilly River Nature Reserve. The management of these buildings was transferred to NPWS in 2009.</p> <p>There are a number of trails within the planning area which are used by NPWS and SCA for management operations such as pest animal and weed control. The trail through Toms Island provides access to an adjacent property. As noted in section 6.4 above, some trails are also used for illegal activities.</p> <p>The western section of Wollondilly River Nature Reserve is accessible via a Crown road through an area of Crown lease. An alternate route to the Bowmans Hill precinct is potentially available by crossing the Wollondilly River through Toms Island.</p> <p>The SCA maintains a water quality monitoring site within the eastern section of Wollondilly River Nature Reserve.</p> <p>A power line and phone line runs through Wollondilly River Nature Reserve to Hartley House. There is no easement for these utilities.</p> <p>The boundary of the reserve is not well defined in a number of locations, and requires review and surveys. This may lead to other uses being detected. A road reserve is located within the western section of Wollondilly River Nature Reserve (see Map 1).</p>	<p>Management operations will not impact on the values of the planning area.</p> <p>Management trails adequately serve management needs and have acceptable environmental impact.</p> <p>Management facilities and operations adequately serve management needs and have minimal impact.</p> <p>Infrastructure and assets are routinely maintained.</p> <p>Existing non-park infrastructure is managed to minimise impacts on natural and cultural values.</p> <p>All other uses of the park will have a neutral or positive impact on the values of the planning area.</p>	<p>6.7.1 The buildings within the Bowmans Hill precinct may be used for management purposes appropriate to their heritage significance. This may include the storage of equipment and materials, and/or short term staff accommodation, and/or as a staff residence.</p> <p>6.7.2 Maintain the roads and management trails shown on Map 1. All other trails will be closed and rehabilitated.</p> <p>6.7.3 Investigate the feasibility of reopening the river crossing from Toms Island as an access point to the Bowmans Hill precinct.</p> <p>6.7.4 Gate the Joadja Ridge management trail in Joadja Nature Reserve to restrict unauthorised access.</p> <p>6.7.5 Restrict unauthorised access to the Special Areas, consistent with the SASPoM.</p> <p>6.7.6 Formalise a licence for the existing phone and power lines in accordance with section 153 of the NPW Act.</p> <p>6.7.7 Permit the SCA to continue operating the water quality monitoring site.</p> <p>6.7.8 Seek the addition of the road reserve into the western section of Wollondilly River Nature Reserve.</p> <p>6.7.9 Negotiate an access agreement to permit access through Toms Island to the adjacent property, consistent with the access to inholdings policy.</p>	<p>Medium</p> <p>Medium</p> <p>Low</p> <p>High</p> <p>High</p> <p>Low</p> <p>Ongoing/Medium</p> <p>Low</p> <p>Low</p>

\* **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.

**Ongoing** is for activities that are undertaken on an annual basis or statements of management intent that will direct the management response if an issue arises.