NSW NATIONAL PARKS & WILDLIFE SERVICE

Mother of Ducks Lagoon Nature Reserve

Plan of Management

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Cover photo: View from Mother of Ducks Lagoon Nature Reserve birdwatching platform. John Spencer/DPIE

Acknowledgments: DPIE acknowledges that Mother of Ducks Lagoon Nature Reserve is in the traditional Country of the Banbai Aboriginal People.

This plan of management was prepared by staff of the NSW National Parks and Wildlife Service (NPWS), part of DPIE. For additional information or any inquiries about this plan of management, contact NPWS at 145 Miller Street, Armidale, or by telephone on 02 6738 9100.

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Environment, Energy and Science
Department of Planning, Industry and Environment
Locked Bag 5022, Parramatta NSW 2124
Phone: +61 2 9995 5000 (switchboard)
Phone: 1300 361 967 (Environment, Energy and Science enquiries)
TTY users: phone 133 677, then ask for 1300 361 967
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Contents

List of tables

List of figures

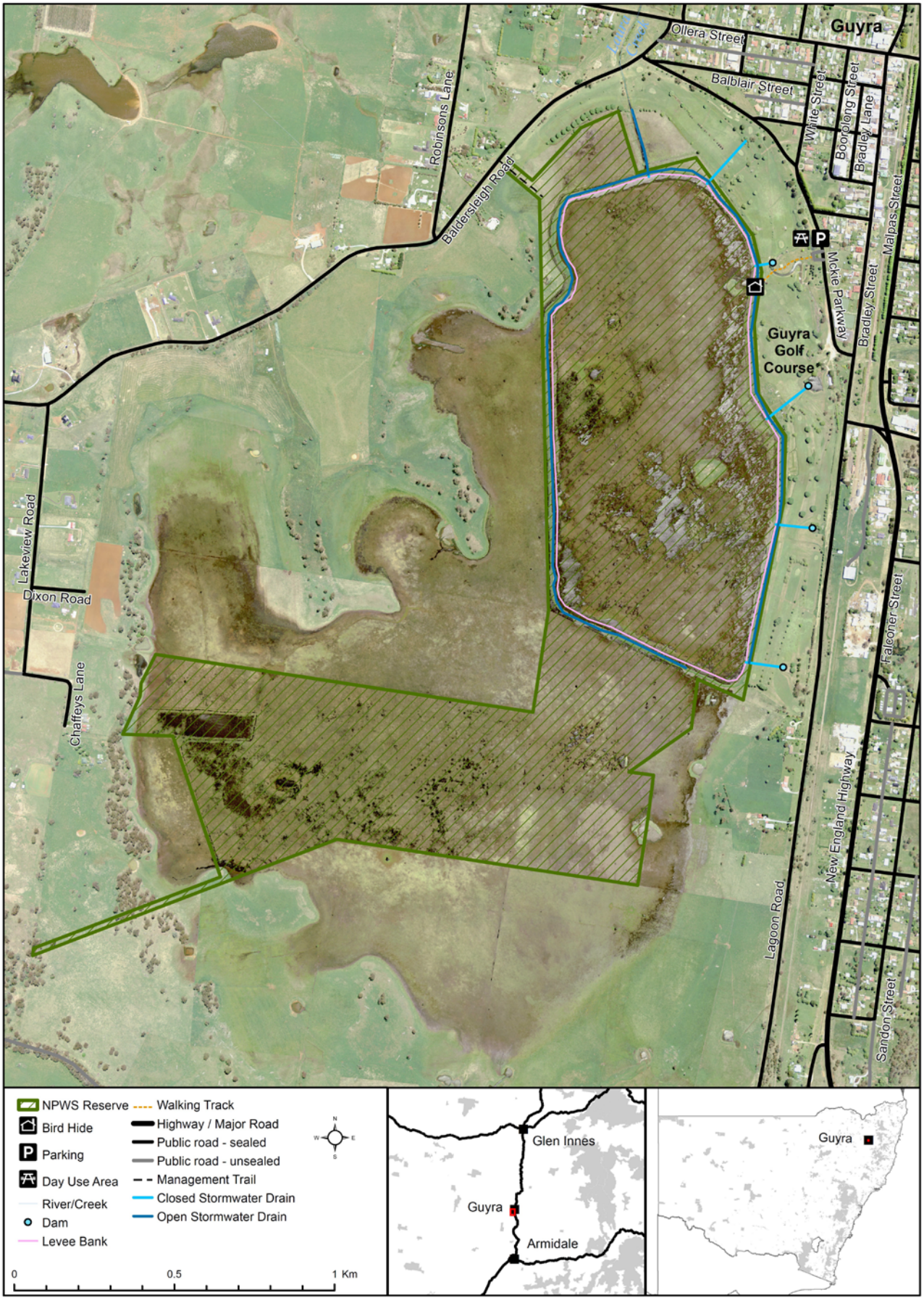

Figure 1 **Mother of Ducks Lagoon Nature Reserve**

1. Introduction

1.1 Location, reservation and regional context

Feature	Description
Mother of Ducks Lagoon Nature Reserve	
Location	Mother of Ducks Lagoon Nature Reserve (referred to as 'the reserve' in this plan) adjoins the township of Guyra on the Northern Tablelands of New South Wales. The reserve is accessible from Guyra off the New England Highway (see Figure 1). Public pedestrian access to the reserve is available from McKie Parkway, near the Guyra Golf Course, in the north-east area of the reserve.
Area	The reserve covers 195 hectares and is part of a larger lagoon basin covering approximately 340 hectares. The reserve is located close to the watershed of the Great Divide at an elevation of 1315 metres.
Reservation date	The first section to be reserved, in 1973, was 97 hectares. A second area of 84 hectares, in the south, was added in 2005. Two smaller additions of 5 and 9 hectares were added in 2010 and 2011 respectively.
Previous tenure	The first area reserved was Crown land. Subsequent additions were purchases of freehold grazing land.
Regional context	
Biogeographic region	The reserve is within the New England Tablelands Bioregion.
Surrounding land use	Most of the surrounding land has been cleared and is now used for grazing and for the Guyra Golf Course. There is urban development to the north-east at Guyra and small acreages on the western and eastern sides of the lagoon.
Other authorities	The reserve is located within the administrative areas of the Armidale Regional Council, Northern Tablelands Local Land Services and the Guyra Local Aboriginal Land Council.

1.2 Statement of significance

Mother of Ducks Lagoon Nature Reserve is significant for the following reasons:

Biological values

- The lagoon is one of 58 natural freshwater wetlands on the New England Tableland and one of only three in NSW national parks estate.
- The reserve contains two threatened ecological communities: Upland Wetlands of the Drainage Divide, and a small area of Ribbon Gum – Mountain Gum – Snowy Gum Grassy Forest/Woodland listed on the *Biodiversity Conservation Act 2016*. The Upland Wetlands community is also listed as an endangered ecological community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* as Upland Wetlands of the New England Tablelands and the Monaro Plateau.
- The reserve provides habitat for three bird species listed as endangered (including one listed as critically endangered at the national level) and nine bird species listed as vulnerable under the Biodiversity Conservation Act.
- Seven bird species listed under international migratory bird agreements have been recorded in the reserve.

Geological, landscape and hydrological values

- The bed of the lagoon has an unusually deep (up to 500 millimetres) formation of peaty soil that lies in a saucer-shaped, basalt-lined depression.
- The lagoon provides a significant scenic backdrop to the township of Guyra, particularly when it is full of water.
- The hydrology of the wetland supports upland wetland threatened ecological communities.

Research and educational values

- The reserve has research and educational value for its unusual hydrological features, which are both natural and modified. It is also a significant site for resident, endemic and international migratory bird populations.

2. Management context

2.1 Legislative and policy framework

The management of national parks in New South Wales is in the context of the legislative and policy framework of the NSW National Parks and Wildlife Service (NPWS), primarily the *National Parks and Wildlife Act 1974* and National Parks and Wildlife Regulation, the *Biodiversity Conservation Act 2016* and the policies of NPWS.

Other legislation, strategies and international agreements may also apply to management of the area. The NSW *Environmental Planning and Assessment Act 1979* may require assessment of the environmental impact of works proposed in this plan. The NSW *Heritage Act 1977* may apply to the excavation of known archaeological sites or sites with potential to contain historic archaeological relics. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* may apply in relation to actions that impact matters of national environmental significance, such as migratory and threatened species listed under that Act and places on the National Heritage List.

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

2.2 Management purposes and principles

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

Under the National Parks and Wildlife Act (section 30J), nature reserves are managed to:

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

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

2.3 Specific management directions

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

- conserve habitat values for upland wetland threatened ecological communities, threatened plants and animals
- control pest animal and plant species in accordance with the pest management strategies relevant to the reserve
- encourage appropriate visitation to the reserve.

3. Values

This plan aims to conserve both the natural and the cultural values of the reserve. The location, landforms and plant and animal communities of the area have determined how it has been used and valued by both Aboriginal and non-Aboriginal people. These values may be attached to the landscape as a whole or to individual components, for example, the plant and animal species used by Aboriginal people. To make this plan clear and easy to use, various aspects of natural heritage, cultural heritage, threats and ongoing use are dealt with individually although these features are interrelated.

3.1 Geology, landforms and hydrology

The Mother of Ducks Lagoon is one of 58 natural, ephemeral, freshwater wetlands on the New England Tableland (Bell et al. 2007 cited in Hunter 2015; Smith 1998), of which only 28% are considered intact and in good condition (Bell et al. 2008). Before drainage works, it is thought that Mother of Ducks Lagoon was the largest freshwater wetland on the tableland (Brock et al. 1999). The reserve contains upland wetlands, which are listed under the Biodiversity Conservation Act and the Environment Protection and Biodiversity Conservation Act.

Mother of Ducks Lagoon is in the flat, upper valley of Laura Creek and bounded by the Great Divide to the east and south. Water draining from the lagoon flows into the Gwydir River (approximately 50 kilometres to the west) via Laura Creek, and from the Gwydir into the Murray–Darling system. Before drainage works in the 1960s, water drained into Laura Creek and the Gwydir River only in very wet years. The reserve is located at an elevation of 1315 metres, which is just below the highest point of the Great Divide in this area. The lagoon has only a small catchment (900 hectares) relative to its surface area. Wetlands such as the reserve are often referred to as watershed wetlands (Haworth 1994).

The lagoon is ephemeral and subject to an irregular cycle of filling and drying. The average annual rainfall for the area is 880 millimetres but annual rainfall is highly variable, with a recorded minimum of 554 millimetres (in 1919) and a recorded maximum of 1378 millimetres (in 1921) (Haworth 1994). Modelled annual average evapotranspiration is 865 millimetres (DHI 2016).

The wetland is a saucer-shaped depression, which is thought to have been formed by one of two geological processes. One possibility is that a landscape inversion may have occurred when Cenozoic era basaltic lava flows partially filled granitic valleys, leaving raised basaltic ridges following erosion of the more erodible granitic material (Lloyd 1992). An alternative is that successive Cenozoic era basalt flows may have formed the broad, flat valleys that allowed the wetland to develop (Briggs 1976).

Soils in the reserve are characterised by gleyed podosols and wiesenbodens in flat areas. The podzolics have significant levels of calcium, magnesium, nitrogen and phosphorus and are intermittently waterlogged. Wiesenbodens contain fewer nutrients and may be deficient in phosphorus. They are finely textured and dark coloured. Soils surrounding the lagoon are mainly krasnozems.

Unique to the New England Tableland lagoons, the bed of Mother of Ducks Lagoon has an unusually deep (300–500 millimetres) formation of peaty soils (Briggs 1976; White 1986b). This peat bed supports an extremely dense and varied native aquatic plant life.

The hydrology of the lagoon has been highly modified by past uses before being reserved. A levee bank was built around part of the wetland in 1987 by the then Soil Conservation Service and NPWS. Four runoff dams were also constructed on the Guyra Golf Course to manage stormwater runoff into the wetland from the township of Guyra and to supplement water levels within the levee bank (see Section 4.2).

Before European settlement the lagoon did not have a defined drainage outlet and only overflowed in exceptionally wet years. An outlet was successfully completed in 1963 (after previous attempts in 1923 and 1951) with the construction of a drain under Baldersleigh Road below the lakebed level. This effectively reduced the lowest point of the lagoon by two metres. This level is lower than the peat layer of the lagoon, resulting in the peat becoming effectively drained during dry periods. The outlet allows the lagoon area on private property to be grazed for longer periods of time than would occur naturally.

In 1987, most of the 97 hectares of land in the reserve were enclosed within a levee bank (see pink line on Figure 1) to retain higher levels of water. The levee was constructed of material taken from the lakebed, with two channels below the peat layer on either side of the levee. This means that the outer lagoon is still drained but the levee bank acts as a partial barrier to slow the movement of water out of the system. The section of the lagoon within the levee does not hold water to a depth greater than one metre before it drains into Laura Creek, thus acting as a surrogate of the natural hydrological regime.

The water level of the inner lagoon within the levee is mostly dependent on direct rainfall. Additional runoff from the Guyra urban area can flow into the lagoon inside the levee via dams and pipes located on the golf course. However, a significant amount of the runoff in this north-east of the catchment does not enter the lagoon within the levee and is diverted directly to the Laura Creek drain. There were concerns in the late 1990s that the levee may have been holding water for longer than natural and creating a more aquatic environment. There are now concerns that the inner lagoon within the levee as well as the outer lagoon may not be getting adequate water.

When the levee was constructed, inlet pipes with one-way flaps were built into the southern wall to allow water to enter the inner lagoon. It is likely that these pipes have never been effective due to the lack of pressure gradient between the inner and outer lagoon areas. This coupled with extended periods of wet and dry has caused them to regularly silt up. Operationally, the maintenance of these flaps is difficult.

Issues

- The hydrology in the lagoon has been significantly modified by past drainage works and construction of the current levee. See also Section 4.2.
- The levee provides significant protection to the Guyra Golf Course and some lower sections of the Guyra urban area that would otherwise be periodically inundated.
- The drain under Baldersleigh Road allows the privately held parts of the lagoon to be grazed and increased inundation may affect grazing potential.
- The inner lagoon within the levee holds water for longer than the outer lagoon, but observation by NPWS suggests that it is not receiving adequate water flows.
- The reserve does not protect the full area of the lagoon floor, which covers an area of 340 hectares.

Desired outcome

- The hydrology of the reserve is managed to maintain the ecological values that are currently under threat.

Management response

3.1.1 In cooperation with Guyra Golf Club and Armidale Regional Council, ensure that the levee bank, dams, drains and other relevant infrastructure associated with the management of the wetland in the reserve are maintained.

3.1.2 If significantly more land is added to the reserve, or with the agreement of affected landholders, investigate options to reinstate a more natural hydrological regime over a larger portion of the lagoon.

3.1.3 Re-establish monitoring of water levels in the lagoon, on either side of the levee.

3.2 Native plants

The vegetation in the reserve can be described as a closed to moderately dense sedgeland and grassland with areas of open water extending across shallow or dry lagoons (Benson & Ashby 2000). The vegetation is mainly ground covers of water plants, sedges, forbs and grasses. Species present vary seasonally, depending on rainfall and depth of the lagoon. Some of the key species recorded and likely to dominate at times include perennial aquatic herbs such as *Myriophyllum variifolium* and *Potamogeton tricarinatus*, Australian sweetgrass (*Glyceria australis*), pennywort (*Hydrocotyle tripartita*, and other perennials such as *Nymphoides geminata* and *Eleocharis acuta* (Bell et al. 2008; Benson & Ashby 2000).

The threatened ecological communities in the reserve are listed in Table 1. Both NSW-listed communities are restricted to the New England Tablelands Bioregion. The wetlands that make up approximately 179 hectares of the reserve are part of an endangered ecological community listed under both NSW and Commonwealth legislation. The other endangered ecological community present is the Ribbon Gum – Mountain Gum – Snowy Gum Grassy Forest/Woodland of the New England Tablelands. Only a very small area (0.5 hectares) of this community is mapped in the reserve (Hunter 2015).

Table 1. Threatened ecological communities recorded in the reserve

Community name (short title)	Status [A]	
	BC Act	EPBC Act
Upland Wetlands of the Drainage Divide [B]	Endangered	Endangered
Ribbon Gum – Mountain Gum – Snowy Gum Grassy Forest/Woodland	Endangered	

[A] BC Act = Biodiversity Conservation Act; EPBC Act = Environment Protection and Biodiversity Conservation Act.

[B] Listed under the Environment Protection and Biodiversity Conservation Act as Upland Wetlands of the New England Tablelands and the Monaro Plateau.

Upland wetlands are not typically connected to rivers or streams, but rather occur in depressions in the landscape. The persistence of these wetlands throughout the year depends on the depth of the wetland, runoff, rainfall patterns and past or current disturbances. These wetlands are generally distinguished by lacking or having only a thin layer of peat underlying the vegetation. Mother of Ducks Lagoon is unique in that it has a deep layer of peat relative to other upland wetlands.

The upland wetlands of the New England Tablelands Bioregion, including Mother of Ducks Lagoon, provide a mosaic of habitats across the landscape (Brock & Jarman 2000). Most of the upland wetlands are shallow and naturally temporary with a variety of patterns of filling and drying. Some are near-permanent, others are seasonal and dry and wet annually, and some are intermittent and have unpredictable seasonal patterns (Boulton & Brock 1999). The reserve is one of only three upland wetlands in NPWS estate, the others being Little Llangothlin and Billy Bung, both within Little Llangothlin Nature Reserve north of Guyra.

Before settlement of the area in the 1830s and the start of extensive clearing in the 1870s (Wright 1964), the New England Tableland was generally covered by grassland communities with a woodland canopy. Wetlands such as Mother of Ducks Lagoon were cleared and, in some cases, drained by the early settlers to improve grazing potential. As a result, there are few, if

any, of the original mature trees left in or around the reserve. Liaison with surrounding landholders is therefore of high importance to encourage the retention and appropriate management of habitat adjacent to the reserve.

Only a small area of the reserve (approximately 0.5 hectares) has tree cover, which is the threatened ecological community, Ribbon Gum – Mountain Gum – Snowy Gum Grassy Forest/Woodland. This community is found on the road reserve in the south-west and a small stand on the north-west boundary (Hunter 2015).

The regionally significant strapleaf woodruff (*Asperula charophyton*), a herb, is known to occur along the levee bank.

Strategies for the recovery of threatened species, populations and ecological communities have been set out in a statewide *Biodiversity Conservation Program* (OEH 2017). These actions are currently prioritised and implemented through the *Saving our Species* program, which aims to maximise the number of threatened species that can be secured in the wild in New South Wales for 100 years (OEH 2013a).

Issues

- The reserve is threatened by pest plants, mainly exotic perennial grasses and willow species.
- The biodiversity of the upland wetlands is threatened by the alteration of water regimes resulting from past clearing and drainage and damming works.
- Grazing by pest animals and stray stock can reduce vegetation and habitat values.

Desired outcomes

- Populations of significant plant species and ecological communities are conserved.
- Negative impacts on native vegetation are minimised.
- Plant diversity and habitat values are restored in degraded areas.

Management response

3.2.1 Implement relevant strategies in line with the *Biodiversity Conservation Program* for threatened plant species, populations and communities occurring in the reserve. Strategies may include mapping the location and extent of ecological communities, fencing, weed control, managing the impacts of fire and visitors, and rehabilitation where appropriate.

3.2.2 Prevent further draining or damming of the threatened ecological communities.

3.2.3 Liaise with neighbours and Armidale Regional Council to encourage the retention and appropriate management of key habitats and corridors adjacent to the reserve.

3.3 Native animals

The reserve offers habitat and refuge for waterbirds, terrestrial birds, amphibians, reptiles and some mammals. More than 87 species of waterbirds and terrestrial birds have been observed in and around the reserve, including three endangered species and 13 species listed as vulnerable under the Biodiversity Conservation Act (see Table 2).

The international significance of the reserve is recognised by the presence of many migratory birds listed under international agreements such as the Japan–Australia Migratory Bird Agreement 1974 (JAMBA), China–Australia Migratory Bird Agreement 1986 (CAMBA) and the Republic of Korea–Australia Migratory Bird Agreement 2006 (ROKAMBA).

Table 2. Threatened and significant animals in the reserve

Common name	Scientific name	Status [A]	
		BC Act	EPBC Act
Birds			
Australian painted snipe	*Rostratula australis*	Endangered	Endangered
Australasian bittern	*Botaurus poiciloptilus*	Endangered	Endangered
Blue-billed duck	*Oxyura australis*	Vulnerable	
Brolga	*Grus rubicunda*	Vulnerable	
Curlew sandpiper	*Calidris ferruginea*	Endangered	Critically endangered, Migratory
Diamond firetail	*Stagonopleura guttata*	Vulnerable	
Flame robin	*Petroica phoenicea*	Vulnerable	
Latham's snipe	*Gallinago hardwickii*		Migratory
Little eagle	*Hieraaetus morphnoides*	Vulnerable	
Little lorikeet	*Glossopsitta pusilla*	Vulnerable	
Marsh sandpiper	*Tringa stagnatilis*		Migratory
Pacific golden plover	*Pluvialis fulva*		Migratory
Red-necked phalarope	*Phalaropus lobatus*		Migratory
Scarlet robin	*Petroica boodang*	Vulnerable	
Sharp-tailed sandpiper	*Calidris acuminata*		Migratory
Speckled warbler	*Pyrrholaemus sagittatus*	Vulnerable	
Varied sittella	*Daphoenositta chrysoptera*	Vulnerable	
White-winged black tern	*Chlidonias leucopterus*		Migratory

[A] BC Act = Biodiversity Conservation Act; EPBC Act = Environment Protection and Biodiversity Conservation Act.
Source: Atlas of NSW Wildlife (BioNet) and local records.

The grassy meadows and swamps, which are intermittently inundated, support the greatest abundance of waterbirds, with fewer birds inhabiting areas of open water (Briggs 1976). White (1986a) suggested that the lagoon is used by birds mainly for foraging and resting and is not highly significant as breeding habitat for waterbirds. Black swans (*Cygnus atratus*) and Pacific black ducks (*Anas superciliosa*) are commonly found in the reserve and generally dominate in numbers. The reserve forms part of a network of wetlands on the New England Tableland that collectively supports large numbers of waterbirds.

Several reptiles, including the common snake-necked tortoise (*Chelodina longicollis*), highlands copperhead snake (*Austrelaps ramsayi*), eastern brown snake (*Pseudonaja textilis*) and red-bellied black snake (*Pseudechis porphyriacus*) have been recorded in the reserve.

Issues

- Weed species and pest animals can reduce habitat values and affect native animals.

Desired outcomes

- Populations of threatened and significant animal species are conserved.
- Negative impacts on threatened and migratory species are minimised.
- The habitat and populations of all threatened and migratory animal species are protected and maintained.

Management response

3.3.1 Implement relevant strategies in line with the *Biodiversity Conservation Program* and relevant individual recovery plans for threatened animal species and populations occurring in the reserve. Strategies include fencing, control of weeds and pest animals, and fire management.

3.4 Aboriginal connections to Country

The reserve lies within the traditional Country of the Banbai Aboriginal People and in the Guyra Local Aboriginal Land Council. The land, water, plants and animals within a landscape are central to Aboriginal spirituality and contribute to Aboriginal identity. Aboriginal communities associate natural resources with the use and enjoyment of foods and medicines, caring for the land, passing on cultural knowledge, kinship systems and strengthening social bonds. Aboriginal heritage and connection to nature are inseparable and need to be managed in an integrated manner across the landscape.

Before European settlement, the Northern Tablelands provided resources for Aboriginal people throughout the year. Resource use in the tablelands is believed to have focused on woodlands, native grasslands and swamplands (Sullivan no date). Wetlands, such as Mother of Ducks Lagoon, provided materials for weaving, such as reeds, and wetland plants and animals for food.

Little appears to have been recorded of the Aboriginal occupation and associations of the Guyra region at the time of European settlement. It is thought that a single tribe occupied the area around Oban, Copes Creek, Ollera, Guyra and Black Mountain. Belshaw (1978) suggests the Northern Tablelands may have been a ‘marchland’ between well-defined tribal groups to the east and west. Permanent occupation may have been sparse, estimated to be 500–600 people, due to the harsh environment of the tablelands (Binns & McBryde 1972).

Artefacts have been located across the tablelands and even though there are no known Aboriginal sites within the reserve, there are several recorded sites nearby.

While the NSW Government has legal responsibility for the protection of Aboriginal sites and places, NPWS acknowledges the right of Aboriginal people to make decisions about their own heritage. Aboriginal communities will be consulted and involved in managing Aboriginal sites, places and related issues, and in promoting and presenting Aboriginal culture and history.

Issues

- There have been no formal cultural surveys or research to determine the Aboriginal heritage values of the reserve.

Desired outcomes

- Aboriginal places and values are identified and protected.
- Aboriginal people are involved in managing Aboriginal cultural values of the reserve.
- Understanding of the cultural values of the reserve is improved.

Management response

3.4.1 Consult and engage Guyra Local Aboriginal Land Council, Elders groups, other relevant Aboriginal community organisations and custodial families in the management of their Country, including through further survey, research and management of Aboriginal sites and places.

3.4.2 Undertake heritage assessments before undertaking any works that have potential to impact Aboriginal sites or values.

3.4.3 Provide opportunities for Aboriginal people to access Country to maintain, renew or develop cultural practices and associations.

3.5 Shared heritage

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

The first European to visit the New England Tableland was John Oxley in 1818. Europeans first settled in the area during the pastoral expansion of the early 1830s, and by the 1860s the lagoon and its perimeter were being used for cattle grazing (Walker 1966).

In the 1860s the lagoon was declared a Water Supply Reserve. Extensive clearing began in the 1870s (Wright 1964), and wetlands were often the first areas to be reclaimed for grazing (Briggs 1976). In the early 1890s, a Travelling Stock and Camping Reserve was declared over the lagoon with the earlier water supply declaration being revoked.

In 1894, following observations of the wildlife by the early settlers, particularly waterbirds, the lagoon was gazetted as a Public Reserve. The then Guyra Shire Council and the NSW Fauna Panel had joint management responsibility for the lagoon from the early 1900s. In 1904 the lagoon was declared a Town Common and was a popular picnic area. For a period, there was a small paddle steamer, the *Florrie*, taking day trippers from the town to picnic sites along the wooded southern shores.

The Guyra Show Ground was in the area between 1906 and 1908. The northern perimeter of the lagoon served as a horse-racing track from early in the century to 1920 and again between 1928 and the early 1930s. In 1914, the lagoon was declared a Fauna Protection Area.

Three attempts were made to lower the water level of the lagoon in 1923, 1951 and 1963. This was done to increase the area of land for grazing, for soldier settlement blocks after World War I and, later, to establish the golf course.

Before dedication as a nature reserve under the National Parks and Wildlife Act in 1973, the area was known as the Guyra Common and was grazed and used for recreation. From 1973, NPWS managed the north-east section of the lagoon for wetland restoration and the rehabilitation of waterfowl populations. However, the cumulative effects of drainage and continued illegal use for grazing limited the ecological values of the reserve. All grazing rights on the reserve were revoked in 1978.

In response to community concerns over the impact of the drying of the lagoon and its aesthetic impact on Guyra, a detailed study of possible options was undertaken (Creek 1982). An Australian Bicentennial Project grant enabled work to restore water levels in the reserved portion of the lagoon. In 1987 an earthen levee bank was constructed around the then area of the reserve with the aim of creating a more persistent but still ephemeral water body, better able to fulfil its original ecological functions.

Desired outcomes

- Negative impacts on historic heritage values are minimised.
- Understanding of the cultural values of the reserve is improved.

Management response

3.5.1 Record historic sites as found and assess their significance.

3.5.2 Undertake an archaeological survey and cultural assessment before undertaking any works with the potential to impact any historic sites and places.

3.6 Visitor use and research

NPWS parks provide a range of visitor opportunities. NPWS aims to ensure that visitors experience, enjoy and appreciate parks at the same time as conserving and protecting park values.

Current visitation in the reserve is centred on low-impact, nature-based recreation, such as walking and birdwatching. Visitor use of the reserve varies and is often dependent on the abundance of birdlife using the lagoon at the time. Visitor facilities within the reserve managed by NPWS consist of a birdwatching platform with interpretive material located over the lagoon (see Figure 1 and cover photo).

Visitors and local residents sometimes walk on the eastern section of the levee wall and NPWS maintains this area by mowing occasionally. There have been discussions with local authorities and the community about the possibility of establishing a more permanent walking track on the levee bank with the increased maintenance effort being met by the community. NPWS would support this proposal on the eastern section of the levee wall only. Access to other sections of the levee will be discouraged due to likely disturbance to waterbirds.

Council facilities adjacent to and associated with the reserve include a picnic shelter and tables, a walking track to the birdwatching platform, with footbridges over wetter areas, an information structure and a car park (see Figure 1).

There is no direct public vehicle access to the reserve. However, it is only a short walk from the council car park and picnic area on McKie Parkway to the north-east of the reserve (see Figure 1). No camping or fires are permitted in the reserve.

The reserve provides research and education opportunities for its unusual hydrological and biotic values and for its significant resident, endemic and migratory bird populations. It has also been the site of a wide range of investigations and surveys in the past. Future research on the management of the water regime is particularly critical to ensure healthy functioning of the lagoon ecosystem.

Desired outcomes

- Visitor use of the reserve is appropriate and ecologically sustainable.
- Negative impacts of visitors on reserve values are minimised.
- Visitor opportunities encourage appreciation and awareness of the reserve's values and the importance of their conservation.
- Improved understanding of the lagoon's inundation regimes and the subsequent impacts on biodiversity.

Management response

3.6.1 Provide and promote opportunities for low-impact, nature-based recreation in the reserve, such as walking and birdwatching.

3.6.2 Pending environmental and feasibility assessments, establish a low-maintenance walking track on the eastern section of the levee wall in cooperation with local authorities and the community.

3.6.3 Maintain and provide interpretive material at the birdwatching facility. Subject to resource availability and feasibility assessments, provide interpretive material for the information structure in the council car park, in consultation with local authorities.

3.6.4 Promote use of the reserve for research to improve knowledge on significant waterbirds, threatened species and communities, and management of the hydrology of the wetland.

3.6.5 Maintain the existing birdwatching facility and, subject to demand, feasibility and environmental assessments, construct or upgrade other appropriate visitor infrastructure in consultation with Armidale Regional Council, as resources allow.

3.6.6 Maintain contact with neighbours and the community to raise awareness of the reserve's significance.

4. Threats

4.1 Pest species

Pest species are plants, animals and diseases that have negative environmental, economic and social impacts. They are most commonly introduced species. Pests can have impacts across the range of reserve values, including impacts on biodiversity, cultural heritage, catchment and scenic values. Pest species are recognised as a major threat to the reserve's significant biodiversity values.

The *Biosecurity Act 2015* and its regulations provide specific legal requirements for the response, management and control of biosecurity risks, including weeds and pest animals. These requirements apply equally to public and privately owned land. Under this framework, Local Land Services (LLS) has prepared regional strategic weed management plans and regional strategic pest animal management plans for each of its 11 regions, including the Northern Tablelands Region (Northern Tablelands LLS 2017, 2018).

The LLS plans identify priority weeds and pest animals in each of the regions, plus the appropriate management response for the region (i.e. prevention/alert, eradication, containment or asset protection).

NPWS prepares regional pest management strategies that identify pest species and priorities for control, including strategies listed in the *Biodiversity Conservation Program* (see Sections 3.2 and 3.3), threat abatement plans, and other strategies such as Local Land Services' regional strategic pest management plans, the NSW *Biodiversity Priorities for Widespread Weeds* (DPI & OEH 2011) and the *NSW Biosecurity Strategy 2013–2021* (DPI 2013).

The overriding objective of the NPWS pest management strategy is to minimise adverse impacts of introduced species on biodiversity and other park and community values while complying with legislative responsibilities. The strategy also identifies where other site- or pest-specific plans or strategies need to be developed to provide a more detailed approach. Significant pest species recorded in the reserve are listed in Table 3 and discussed below.

Table 3. Weeds and pest animals recorded in the reserve

Common name	Scientific name	Comment
Weeds		
Black thistle	*Cirsium vulgare*	Throughout the reserve
Blackberry	*Rubus fruticosus* [1,4]	Isolated plants
Hemlock	*Conium maclatum*	Levee wall
Nodding thistle	*Carduus nutans* [5]	Throughout the reserve
St John's wort	*Hypericum perforatum* [5]	Small infestations
Willow	*Salix* spp. [A]	Seed blows in from adjoining areas and germinates
Pest animals		
Brown hare	*Lepus europaeus*	Throughout the reserve when dry
European rabbit	*Oryctolagus cuniculus* [B,C,D]	Generally seen on the levee bank but may be seen in the lagoon during dry periods
Feral cat	*Felis catus* [2,3]	Thought to occur within the reserve given its proximity to Guyra
Goldfish	*Carassius auratus*	Primarily in drains associated with the levee

Common name	Scientific name	Comment
Plague minnow	*Gambusia holbrooki* [5,2]	Throughout the inundated part of the reserve
Red fox	*Vulpes vulpes* [2,3,5]	Generally seen on the levee bank but may be seen in the lagoon during dry periods and nesting season of birds

[1] Weed of National Significance (Australian Government no date).

[2] Key threatening process under Biodiversity Conservation Act.

[3] Key threatening process under Environment Protection and Biodiversity Conservation Act.

[4] State-level priority weed (Northern Tablelands LLS 2017).

[5] Regional level priority weed or pest animal (Northern Tablelands LLS 2017, 2018).

Common pest plants in the reserve include jointed rush (*Juncus articulatus*) and perennial grasses. Australian sweetgrass and jointed rush have similar emergent growth forms, and the former is important habitat for waterfowl (Smith 1998; Sims & Thoms 2003). The levee bank is often infested with weeds and this is a continual seed source for the reserve (Hunter 2015). Willows regularly spread into the reserve from neighbouring areas. There is also a need to monitor the reserve for any incursion of Coolatai grass (*Hyparrhenia hirta*).

Goldfish occur in the lagoon and at high densities may compete with waterbirds for invertebrate food resources. The plague minnow or mosquito fish is also present and is listed as a key threatening process under the Biodiversity Conservation Act. There are no feasible options for control of these two species in the reserve at this time. It is highly likely that the internal drain resulting from the construction of the levee holds surface water for a longer period than would naturally occur and allows populations of both fish to rapidly expand when the lagoon is inundated.

Many of the pest animals recorded in the reserve are identified as key threatening processes and have adverse impacts on the biodiversity and habitat values of the reserve. Both red foxes and European rabbits have colonised the levee bank, with foxes proving difficult to eradicate due to continuous recruitment from adjoining pastoral lands. It is highly likely that cats occur in the reserve.

Red foxes

Red foxes suppress native animal populations, particularly those of small to medium-sized mammals, ground-nesting birds and freshwater turtles. They exert significant predation pressure on birds in the reserve, and in drier times may access the centre of the lagoon within the levee and prey on ground-dwelling animals at peak nesting times. They have also been implicated in the spread of several weed species, such as blackberries.

Predation by the red fox is a key threatening process under the Biodiversity Conservation Act and the Environment Protection and Biodiversity Conservation Act. The NSW Fox Threat Abatement Plan was initiated in 2001 (and revised in 2010; see OEH 2011) with the primary objective of establishing long-term control programs to protect priority threatened fauna species and populations in New South Wales.

Issues

- NPWS is restricted in the use of some control methods because of the proximity of the reserve to the urban area of Guyra.
- Fences are compromised by the wetland environment, leading to failure and stock incursions.

Desired outcomes

- Pest plants and animals are controlled and where possible eliminated.
- Negative impacts of introduced plant and animal species on reserve values are minimised.

Management response

4.1.1 Continue weed control and pest animal control programs as outlined in pest management strategies relevant to the reserve as resources allow.

4.1.2 Continue to control stock straying into the reserve in cooperation with neighbours.

4.1.3 Survey and monitor the reserve to determine the presence and extent of pest species and identify biodiversity most at risk. Treat, as resources allow, any new outbreaks where possible.

4.1.4 Seek the cooperation of neighbours and the Northern Tablelands Local Land Services in implementing weed and pest control programs.

4.2 Maintenance of water regimes

The hydrology of Mother of Ducks Lagoon, and the reserve, has been highly modified by clearing, drainage works, construction of dams and past uses of the lagoon. Part of the lagoon is now contained within a levee bank constructed in 1987. Further, to manage stormwater runoff from the township of Guyra and to supplement water levels in the lagoon within the levee, four dams were constructed on the Guyra Golf Course to collect water runoff. Water flows from these dams into the portion of the reserve within the levee via closed stormwater drains (see Figure 1). The runoff dams and the associated stormwater drains are owned and managed by the Armidale Regional Council and Guyra Golf Club. The maintenance of the levee bank and channels within the reserve is undertaken by NPWS. Part of the exterior channel (i.e. the channel around the levee bank) is outside the reserve in the Guyra Golf Club. NPWS has maintained parts of the channel outside the reserve previously and will seek a cooperative arrangement with Armidale Regional Council and Guyra Golf Club for future works.

If a larger area of the lagoon beyond the current reserve could be acquired by NPWS, or if agreement can be reached with neighbouring landholders, it might be possible to establish a more natural water regime for the lagoon. One option would be to remove part of the levee on its southern and western sides, while retaining the levee on the northern and eastern sides to protect the golf course and the urban area of Guyra. This action may require construction of a weir or other structure to set a reasonable maximum water depth for the whole lagoon.

If it is not feasible to implement a more natural water regime for the lagoon, then the existing infrastructure feeding water into the lagoon within the levee needs to be assessed. This includes the three 600-millimetre pipes with one-way valves built into the southern wall of the levee. These inlet pipes are unlikely to have ever operated properly owing to an insufficient pressure gradient between the inner and outer lagoon, and are currently silted shut. A hydrological study needs to be carried out to determine whether it is feasible for water to enter the lagoon via this mechanism and if modification is required, or whether the pipes should be permanently closed or removed.

Issues

- The levee and associated infrastructure is important to stop inundation of the Guyra Golf Course and urban Guyra. They also currently allow neighbouring properties longer opportunities for stock grazing.
- The levee and associated infrastructure prevents a natural water regime for the lagoon.

- Regular maintenance is required on the levee and associated infrastructure.

Desired outcomes

- A water regime is implemented that maximises conservation outcomes for the reserve while meeting other community obligations.

Management response

4.2.1 Develop a wetland management plan to protect the values of the reserve and to guide water management activities including infrastructure and maintenance of an effective hydrological regime.

4.2.2 In cooperation with Guyra Golf Club and Armidale Regional Council, ensure that the levee bank, overflow drain, open stormwater drains and closed stormwater drains feeding into the reserve are maintained.

4.2.3 Undertake a hydrological study to determine how best to manage the hydrology of the lagoon in the levee to bring it as close to a natural regime as possible.

4.2.4 If more land is added to the reserve, investigate options to reinstate a more natural water regime.

4.3 Fire

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

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 plant and animal species and communities, and high frequency fires have been listed as a key threatening process under the Biodiversity Conservation Act.

There is little knowledge of the fire history of the reserve before its gazettal. A peat fire in 1901 burned for three months and a drought from 1917 to 1919 led to another fire in the peat bed at some time during this period. There are also records of fires burning the peat bed in 1966, 1985 and 1986.

Apart from the birdwatching platform and interpretive signage, there are no fire-prone built assets within the reserve. Nearby, however, there are privately owned assets, including homes and agricultural infrastructure such as fences, yards, farm buildings and stock. Strategies to defend assets on private property will depend on water levels within the lagoon at the time.

A fire management strategy that defines the fire management approach for the reserve has been prepared and is updated periodically (OEH 2005). The fire management strategy outlines the recent fire history of the reserve, key assets within and adjoining the reserve, including sites of natural and cultural heritage value, fire management zones and fire control advantages, such as management trails and water supply points. It also contains fire regime guidelines for conservation of the reserve's vegetation communities.

NPWS maintains cooperative arrangements with surrounding landowners and the Rural Fire Service, and is actively involved with the New England Bush Fire Management Committee. These cooperative arrangements include fire planning, fuel management and information

sharing. Hazard reduction programs, ecological burning proposals and fire trail works are submitted annually to the bush fire management committee.

Desired outcomes

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

Management response

4.3.1 Implement the fire management strategy for the reserve and update as required.

4.3.2 Continue to be involved in the New England Bush Fire Management Committee and maintain cooperative arrangements with local Rural Fire Service brigades and surrounding landowners regarding fuel management and fire suppression.

4.3.3 Suppress unplanned fires in the reserve in accordance with the reserve fire management strategy.

4.3.4 Manage the reserve to protect biodiversity in accordance with the identified fire regimes in the fire management strategy.

4.4 Isolation and fragmentation

The area surrounding the reserve has been extensively cleared, which has resulted in a high loss of biodiversity and fragmentation of habitat. The reserve is small, isolated and subject to edge effects, which make it vulnerable to disturbance. Adjacent land uses place pressure on the reserve through the incursion of non-native plant and animal species. The hydrology of the lagoon has also been significantly affected by development within its catchment. Neighbouring urban areas and human visitation also affect the reserve through predation by domestic pets, stormwater drainage, encroachments and unauthorised recreation activities. The management of such impacts is complex and requires the cooperation of numerous parties and agencies.

Cooperative arrangements with neighbours are important for the management of access, fire, weeds and pest animals. In addition, 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.

If additional land is acquired for the reserve, rehabilitation of land to enhance existing ecological communities may be required.

Desired outcome

- The negative impacts of isolation and fragmentation are reduced.

Management response

4.4.1 Liaise with neighbours and Armidale Regional Council to encourage the protection, management and enhancement of native vegetation corridors and key habitat on public and private lands near the reserve.

4.5 Climate change

Human-induced climate change has been listed as a key threatening process under the Biodiversity Conservation Act (NSW SC 2000) and the associated loss of habitat is listed under the Environment Protection and Biodiversity Conservation Act (TSSC 2001). The latest information on projected changes to climate are from the NSW and ACT Regional Climate Modelling (NARClim) project (OEH 2014). The climate projections for 2020–2039 are described as 'near future', and projections for 2060–2079 are described as 'far future'. The snapshot shown in Table 4 is for the New England North West, which includes the reserve (OEH 2014).

The projected increases in temperature, number of hot days and severe fire weather days (OEH 2014) are likely to influence bushfire frequency and intensity across the Northern Tablelands Region and the fire season is likely to be extended (DECCW 2010a). These changes will result in changes to fire regimes and widespread alteration to natural ecosystems, particularly the highly vulnerable, higher altitude ecosystems such as those found in the reserve, inland wetlands and highly fragmented ecosystems.

Inland wetlands, such as Mother of Ducks Lagoon, are likely to be at risk from increased temperatures, increased fire frequency and changed rainfall patterns induced by climate change. Wetlands are particularly vulnerable as many have been heavily cleared and are already under threat from weeds and altered water regimes. Therefore, it is likely that these climatic changes will result in significant changes to species composition and structure and a substantial reduction in extent (DECCW 2010b).

Table 4. New England North West climate change snapshot

Projected temperature changes	
Maximum temperatures are projected to **increase** in the near future (2020–2039) by 0.4–1.0°C	Maximum temperatures are projected to **increase** in the far future (2060–2079) by 1.9–2.7°C
Minimum temperatures are projected to **increase** in the near future by 0.5–1.0°C	Minimum temperatures are projected to **increase** in the far future by 1.6–2.7°C
The number of hot days will **increase**	The number of cold nights will **decrease**
Projected rainfall changes	
Rainfall is projected to **decrease** in winter	Rainfall is projected to **increase** in autumn
Projected changes to the Forest Fire Danger Index	
Average fire weather is projected to **increase** during summer, spring and winter	Severe fire weather days are projected to **increase** in summer and spring

Source: OEH 2014.

Climate change may significantly affect biodiversity by changing the size of populations and the distribution of species, modifying species composition, and altering the geographical extent of habitats and ecosystems. The potential impact of climate change on the reserve 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.

NPWS will continue to manage threats to values of the reserve from climate change in a collaborative way with other land managers. The presence of the reserve will improve the resilience of natural and cultural values through the protection of native flora and fauna. Programs to reduce the pressures arising from other threats, such as invasive species and bushfires, will also help reduce the severity of the effects of climate change.

Desired outcomes

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

Management response

4.5.1 Continue existing fire, pest and weed management programs and adapt where required to minimise climate change-induced threats.

5. Implementation

This plan of management establishes a scheme of operations for Mother of Ducks Lagoon Nature Reserve.

Activities identified in the plan are listed in Table 5. Relative priorities are allocated against each activity as follows:

- **High** priority activities are those imperative to achieve the plan's objectives and desired outcomes and must be undertaken in the near future to avoid significant deterioration in natural, cultural or management resources.
- **Medium** priority activities are 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 that arises.

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

Table 5. Management responses and priorities

Plan reference	Management response	Priority
3.1	**Geology, landforms and hydrology**	
3.1.1	In cooperation with Guyra Golf Club and Armidale Regional Council, ensure that the levee bank, dams, drains and other relevant infrastructure associated with the management of the wetland in the reserve are maintained.	Ongoing
3.1.2	If significantly more land is added to the reserve, or with the agreement of affected landholders, investigate options to reinstate a more natural hydrological regime over a larger portion of the lagoon.	High
3.1.3	Re-establish monitoring of water levels in the lagoon, on either side of the levee.	Medium
3.2	**Native plants**	
3.2.1	Implement relevant strategies in line with the *Biodiversity Conservation Program* for threatened species, populations and communities occurring in the reserve. Strategies may include mapping the location and extent of ecological communities, fencing, weed control, managing the impacts of fire and visitors, and rehabilitation where appropriate.	High
3.2.2	Prevent further draining or damming of the threatened ecological communities.	High
3.2.3	Liaise with neighbours and Armidale Regional Council to encourage the retention and appropriate management of key habitats and corridors adjacent to the reserve.	Ongoing
3.3	**Native animals**	
3.3.1	Implement relevant strategies in line with the *Biodiversity Conservation Program* and relevant individual recovery plans for threatened animal species and populations occurring in the reserve. Strategies include fencing, control of weeds and pest animals, and fire management.	High

Plan reference	Management response	Priority
3.4	**Aboriginal connection to Country**	
3.4.1	Consult and engage Guyra Local Aboriginal Land Council, Elders groups, other relevant Aboriginal community organisations and custodial families in the management of their Country, including through further survey, research and management of Aboriginal sites and places.	Ongoing
3.4.2	Undertake heritage assessments before undertaking any works that have potential to impact Aboriginal sites or values.	Ongoing
3.4.3	Provide opportunities for Aboriginal people to access Country to maintain, renew or develop cultural practices and associations.	Ongoing
3.5	**Shared heritage**	
3.5.1	Record historic sites as found and assess their significance.	Ongoing
3.5.2	Undertake an archaeological survey and cultural assessment before undertaking any works with the potential to impact any historic sites and places.	Ongoing
3.6	**Visitor use and research**	
3.6.1	Provide and promote opportunities for low-impact, nature-based recreation in the reserve, such as walking and birdwatching.	Ongoing
3.6.2	Pending environmental and feasibility assessments, establish a low-maintenance walking track on the eastern section of the levee wall in cooperation with local authorities and the community.	Medium
3.6.3	Maintain and provide interpretive material at the birdwatching facility. Subject to resource availability and feasibility assessments, provide interpretive material for the information structure in the council car park, in consultation with local authorities.	Ongoing
3.6.4	Promote use of the reserve for research to improve knowledge on significant waterbirds, threatened species and communities, and management of the hydrology of the wetland.	Ongoing
3.6.5	Maintain the existing birdwatching facility and, subject to demand, feasibility and environmental assessments, construct or upgrade other appropriate visitor infrastructure in consultation with Armidale Regional Council, as resources allow.	Ongoing
3.6.6	Maintain contact with neighbours and the community to raise awareness of the reserve's significance.	Ongoing
4.1	**Pest species**	
4.1.1	Continue weed control and pest animal control programs as outlined in pest management strategies relevant to the reserve as resources allow.	High
4.1.2	Continue to control stock straying into the reserve in cooperation with neighbours.	Medium
4.1.3	Survey and monitor the reserve to determine the presence and extent of pest species and identify biodiversity most at risk. Treat, as resources allow, any new outbreaks where possible.	Ongoing
4.1.4	Seek the cooperation of neighbours and the Northern Tablelands Local Land Services in implementing weed and pest control programs.	High
4.2	**Maintenance of water regimes**	

Plan reference	Management response	Priority
4.2.1	Develop a wetland management plan to protect the values of the reserve and to guide water management activities including infrastructure and maintenance of an effective hydrological regime.	High
4.2.2	In cooperation with Guyra Golf Club and Armidale Regional Council, ensure that the levee bank, overflow drain, open stormwater drains and closed stormwater drains feeding into the reserve are maintained.	High
4.2.3	Undertake a hydrological study to determine how best to manage the hydrology of the lagoon in the levee to bring it as close to a natural regime as possible.	High
4.2.4	If more land is added to the reserve, investigate options to reinstate a more natural water regime.	Medium
4.3	**Fire**	
4.3.1	Implement the fire management strategy for the reserve and update as required.	High
4.3.2	Continue to be involved in the New England Bush Fire Management Committee and maintain cooperative arrangements with local Rural Fire Service brigades and surrounding landowners regarding fuel management and fire suppression.	High
4.3.3	Suppress unplanned fires in the reserve in accordance with the reserve fire management strategy.	High
4.3.4	Manage the reserve to protect biodiversity in accordance with the identified fire regimes in the fire management strategy.	High
4.4	**Isolation and fragmentation**	
4.4.1	Liaise with neighbours and Armidale Regional Council to encourage the protection, management and enhancement of native vegetation corridors and key habitat on public and private lands near the reserve.	Medium
4.5	**Climate change**	
4.5.1	Continue existing fire, pest and weed management programs and adapt where required to minimise climate change-induced threats.	Ongoing

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