DANANBILLA, KOORAWATHA, ILLUNIE AND GUNGEWALLA NATURE RESERVES

PLAN OF MANAGEMENT

NSW National Parks and Wildlife Service

Part of the Department of Environment, Climate Change and Water

August 2009

This plan of management was adopted by the Minister for Climate Change and the Environment on 18th August 2009.

Acknowledgments

The NPWS acknowledges that these reserves are in the traditional country of the Wiradjuri People.

This plan of management is based on a draft plan prepared by staff of the South West Slopes Region of the NSW National Parks and Wildlife Service (NPWS), now part of the Department of Environment, Climate Change and water.

Cover photograph of Dananbilla Nature Reserve by Susie Jackson, NPWS.

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FOREWORD

Dananbilla, Koorawatha, Gungewalla and Illunie Nature Reserves are located between Young, Boorowa and Cowra on the south-west slopes of NSW. The reserves cover a combined area of 5,385 hectares.

The reserves protect a small sample of the vegetation types that existed across this part of the landscape before European settlement. They contain around 200 species of native plants; a grassy woodland community which is listed as an endangered ecological community under the Threatened Species Conservation Act; and a range of fauna, including 11 species listed under the Threatened Species Conservation Act.

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

A draft plan of management for the Dananbilla, Koorawatha, Gungewalla and Illunie Nature Reserves was placed on public exhibition from 11th July until 13th October 2008. The submissions received were carefully considered before adopting this plan.

This plan contains a number of actions to achieve "Better environmental outcomes for native vegetation, biodiversity, land, rivers, and coastal waterways" (Priority E4 in the State Plan) including erosion control, management of regrowth following the removal of grazing, control of introduced plants and animals, and fire management.

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

Carmel Tebbutt MP
Deputy Premier
Minister for Climate Change and the Environment

1. DANANBILLA, KOORAWATHA, GUNGEWALLA AND ILLUNIE NATURE RESERVES

Dananbilla, Koorawatha, Gungewalla and Illunie Nature Reserves (referred to as "the reserves" in this plan) are located between the towns of Young, Boorowa and Cowra in the South West Slopes of NSW. The reserves protect a representative sample of the original ecosystems of the bio-region, and provide a focus for a range of off-reserve conservation measures such as conservation agreements, wildlife refuges and wildlife corridors.

Since 1997, this network of reserves has expanded around Dananbilla Nature Reserve which was gazetted in 1983 and comprised 1855 hectares. Extensions of 387 hectares to the reserve were gazetted in 2001, 190 hectares in 2004 and 2005, and a further 984 hectares were acquired and gazetted in 2008. Koorawatha Nature Reserve, comprising 960 hectares, was gazetted in 2002 with a further 144 hectares gazetted in 2004 and 2005. Gungewalla Nature Reserve (142 hectares) and Illunie Nature Reserve (721 hectares) were gazetted in 2005. While the original Dananbilla Nature Reserve was gazetted over vacant crown land, the other additions consisted of freehold and leasehold lands purchased from private landholders.

Dananbilla and Illunie Nature Reserves are named because of their respective positions on the Dananbilla - Illunie Range. Oral history from one local family traces this name to the location of two shepherds working on a run near General Stewart's Gap in the early pastoral days, which led to the phrase "where Dan an' Bill are" (Keith Butt, pers. comm.). Koorawatha Nature Reserve incorporates the Koorawatha Trig. Koorawatha is an Aboriginal name meaning, "*place of tall pines"* (Dibden, 2004). Gungewalla Nature Reserve is named after the parish in which it is located.

The reserves are located within a largely rural area, administered by the Young, Boorowa and Cowra Councils and fall within the Lachlan Catchment Management Authority area. The Young and Cowra Local Aboriginal Land Council areas cover these reserves.

2. MANAGEMENT CONTEXT

2.1 LEGISLATIVE AND POLICY FRAMEWORK

The management of nature reserves is in the context of a legislative and policy framework, primarily the *National Parks and Wildlife Act 1974* (NPW Act), the NPW Regulation, the *Threatened Species Conservation Act 1995* (TSC Act) and the policies of the National Parks and Wildlife Service (NPWS). The policies are based on the legislative background and internationally accepted principles of park management. They relate to nature conservation, Aboriginal and historic heritage conservation, recreation, commercial use, research and communication.

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

A plan of management is a statutory document under the NPW Act. Once the Minister has adopted a plan, no operations may be undertaken within the Dananbilla, Koorawatha, Gungewalla and Illunie Nature Reserves except in accordance with this plan. This plan will also apply to any future additions to Dananbilla, Koorawatha, Gungewalla and Illunie Nature Reserves. Should management strategies or works be proposed for the nature reserves or any additions that are not consistent with the plan, an amendment to the plan will be required.

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.

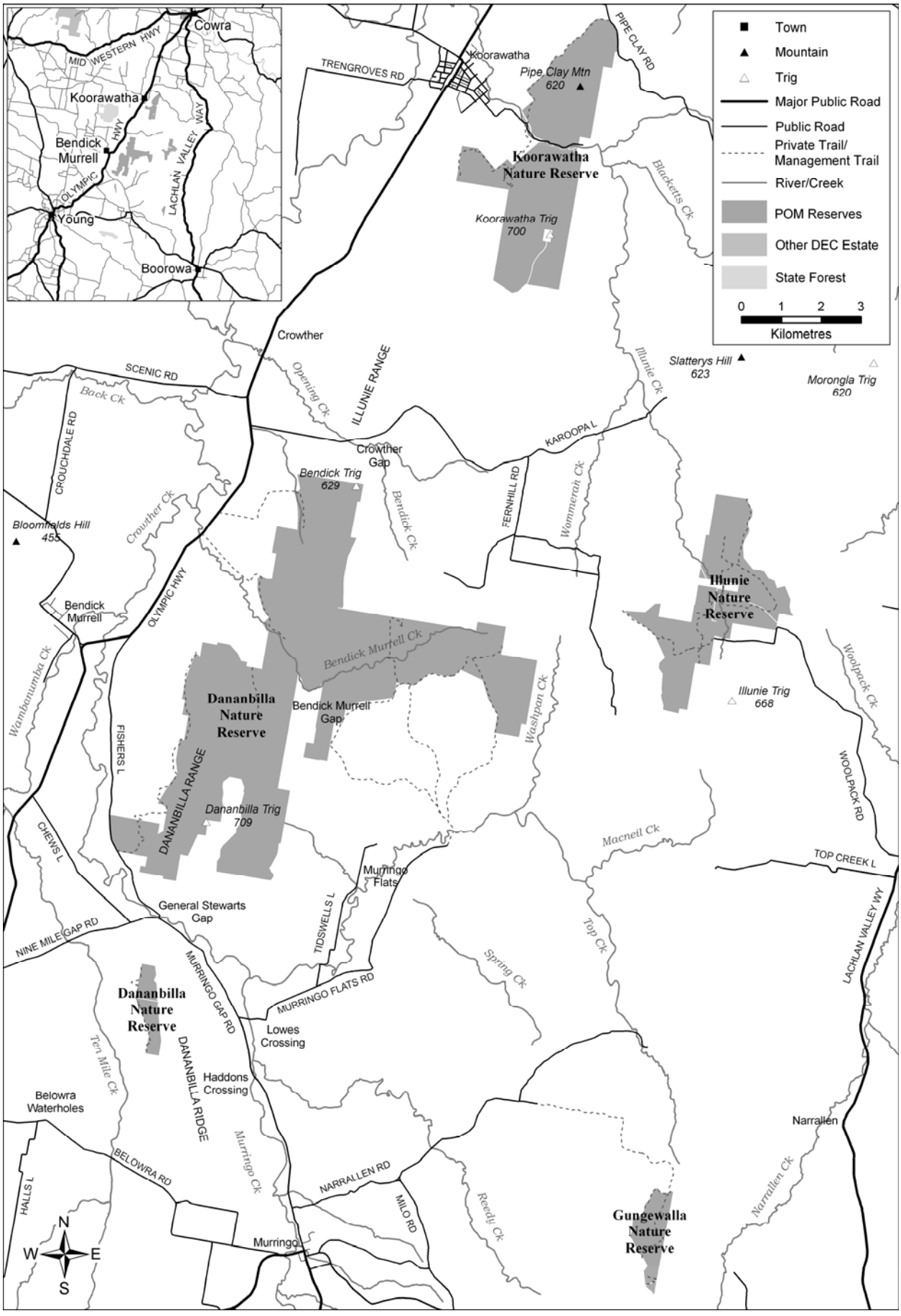
Nature reserves differ from national parks in that they do not have as a management principle to provide for visitor use.

2.3 MANAGEMENT DIRECTIONS

Management of the reserves will focus on the rehabilitation of modified ecosystems to enhance floristic diversity and habitat values.

Liaison with other government agencies, community groups and landholders to enhance habitat off reserve will also be a priority, to reduce the impacts of fragmentation and isolation on reserve values.

MAP: RESERVE MAP



3. VALUES OF THE RESERVES

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, natural heritage, cultural heritage, threats and on-going use are dealt with individually, but their inter-relationships are recognised.

3.1 LANDFORM, GEOLOGY AND SOILS

The reserves are located in the middle catchment of the Lachlan River. Drainage to the Lachlan River is via Back Creek from Dananbilla, Koorawatha and Illunie Nature Reserves, and via the Boorowa River from Gungewalla Nature Reserve.

The reserves occupy an elevational range from the Back Creek valley at below 400 metres to 700 metres at the Koorawatha Trig. Dananbilla and Koorawatha Nature Reserves are situated on the narrow spine of the Dananbilla-Illunie Range immediately east of the Back Creek valley, while Illunie Nature Reserve is sited on the plateau-like extension of the Illunie Range to the south-east of Koorawatha (see map). Gungewalla Nature Reserve is located further south on this undulating range system.

Two main geological time periods are represented within the reserves. The oldest rocks are volcanics associated with the Hawkins Group, deposited during the mid-Silurian period. These volcanics are dominated by welded rhyodacitic ignimbrites, which formed as a result of explosive volcanism within a terrestrial environment.

These strata are unconformably overlain by sedimentary rocks associated with the Late Devonian Hervey Group. The Hervey Group comprises fluvial derived sediments such as conglomerates, sandstones and siltstones, and has undergone low-grade metamorphism.

The Dananbilla and Koorawatha Nature Reserves in the west are located within ranges comprised of the Hervey Group. Parallel bands of the Bumberry and Koorawatha Formations, which consist of siltstone, sandstone and shale are exposed on the western slope, while on the east of the ridge top are narrow bands of Mandagery and Peaks Sandstone, which also contain conglomerate. The crest of the range at both Koorawatha and Dananbilla Nature Reserves is narrow with sandstone exposed on the eastern face due to the upward tilt of the bedding planes on this side.

The eastern extension of Dananbilla Nature Reserve, on rolling topography, is based on Young Granites. To the north, and on the eastern flank of Koorawatha Nature Reserve, these granites are replaced by Illunie Rhyolites, comprising a mixture of rhyolite, dacite, tuff and agglomerate. The footslopes on the west of the range are based on Quaternary alluvium, comprising gravel and sand, while outcrops of the Hawkins Group Volcanics are present in creeks that pass through the ranges in Dananbilla and Koorawatha Nature Reserves in areas where the sandstone has been breached.

The Gungewalla and Illunie Nature Reserves are situated on a broad band of Douro Volcanics to the east of the Young Granites and Illunie Rhyolite, comprising a mixture of dacite, andesite, tuff, sandstone, and shale. Outcrops within the reserves consist of boulders and cooling columns. The boulders are typically rounded and low, but at Illunie Nature Reserve larger boulders are present and in some case overhangs occur within them.

A number of soil types exist across the reserves in relation to the different landscapes and complex geology. These generally comprise Tenosols (Isbell 1996) on the upper steep slopes, Yellow and Red Chromosols on the mid to lower slopes and minor Yellow Sodosols in drainage lines.

The shallow (<0.5 metre) undeveloped soils on the upper slopes comprise moderately acidic (ph 5-6) brown loamy sands overlying a brown sand to loam with only minor clay development, with occasional rock floaters. Soils are rapidly drained and highly permeable with low fertility and low water capacity.

The soils of the mid to lower slopes are deeper (generally >1metre) and have had mixed land use including grazing and minor cropping. Topsoils are generally slightly acidic (ph 6-7) brown sandy loams to clay loams, with moderate structure, extending to 0.2 - 0.3 metre in depth. Organic matter content in the topsoil is relatively high, resulting in moderate levels of nitrogen and phosphorus. There is a clear change to a brown to yellow red sandy clay to medium clay subsoil. The slightly acidic subsoil has low-moderate fertility, has a moderate structure and is moderately well drained.

3.2 NATIVE PLANTS

The reserves protect a small sample of the vegetation types that existed across this part of the landscape before European settlement.

The ridges of Dananbilla and Koorawatha Nature Reserves are covered with a low, shrubby forest of black cypress pine *Callitris endlicheri*, red stringybark *Eucalyptus macrorhyncha* and Dwyer's red gum *E. dwyeri*. The lower western slopes are covered with taller forest of red ironbark *E. sideroxylon* and grey box *E. microcarpa* with a sparse shrubby understorey. Bang Bang Creek in Koorawatha Nature Reserve is flanked by river red gum *E. camaldulensis*, river bottlebrush *Callistemon sieberi* and weeping boree *Acacia vestita*.

Deeper and more fertile soils on the eastern slopes of the reserves and in valley floors support grassy woodland of yellow box *E. melliodora* or white box *E. albens*, often with Blakely's red gum *E. blakelyi*. Extensive areas of woodland dominated by white box occur on rolling hills in the upper Bendick Murrell Creek catchment in eastern Dananbilla. This white box - yellow box - Blakely's red gum woodland community is listed as an endangered ecological community under the *Threatened Species Conservation Act, 1995*.

The undulating ridges and valleys of Illunie and Gungewalla Nature Reserves protect a diverse forest of red ironbark, red stringybark, black cypress pine, white box, red box *E. polyanthemos*, grey box, long-leaved bundy *E. goniocalyx* and Dwyer's red gum *E. dwyeri.* Yellow box woodland occurs on broad valley floors with apple box *E. bridgesiana* along creek-lines.

The reserves have a high native species richness, totalling some 200 species, including grasses, graminoids and forbs in grassy woodlands, with ridges dominated by trees and shrubs. Many species of forbs regarded as indicators of sites of good condition are found in the reserves, some in large populations. Many of these forb species are declining in abundance across the broader landscape in response to agricultural practices such as grazing and cultivation. These include murnong (yam daisy) *Microseris lanceolata*, nodding chocolate lily *Dichopogon fimbriatus*, vanilla lily *Arthropodium milleflorum*, small vanilla lily *Arthropodium minus*, bulbine lily *Bulbine bulbosa*, early Nancy *Wurmbea dioica*, onion orchid *Microtis unifolia*, slender-sun orchid *Thelymitra pauciflora* and common buttercup *Ranunculus lappaceus*. A single sweet quandong *Santalum acuminatum*, generally occurring to the west of here, has been recorded in Koorawatha Nature Reserve.

3.3 NATIVE ANIMALS

The varied habitat within the reserves supports a range of fauna, including the swamp wallaby *Wallabia bicolor*, wallaroo *Macropus robustus*, yellow-footed antechinus *Antechinus flavipes,* and the spotted-tailed quoll *Dasyurus maculata* which is listed as vulnerable under the TSC Act. Five species of arboreal mammal have been recorded, including the yellow-bellied glider *Petaurus australis* and squirrel glider *Petaurus norfolcensis*, both listed as vulnerable under the TSC Act. Nine species of bat have been recorded, including the threatened large-footed myotis *Myotis adversus.*

A large number of bird species have been recorded in the nature reserves, including threatened species such as the glossy black cockatoo *Calyptorhynchus lathami*, swift parrot *Lathamus discolour*, superb parrot *Polytelis swainsonii* and turquoise parrot *Neophema pulchella*. A number of threatened woodland birds including the grey crowned babbler (eastern subspecies) *Pomatostomus temporalis* ssp *temporalis,* brown treecreeper (eastern subspecies) *Climacteris picumnus* ssp *victoriae*, diamond firetail *Stagonopleura guttata,* hooded robin *Melanodryas cucullata*, black-chinned honeyeater *Melithreptus gularis gularis* and speckled warbler *Sericornis sagittatus* have also been recorded in the area. These fauna are threatened due to a combination of factors including loss of habitat and connectivity, predation and inappropriate fire regimes. The reserves provide an important contribution to their protection.

Other threatened birds that have been recorded off reserve within the broader region include painted honeyeater *Grantiella picta*, regent honeyeater *Xanthomyza phrygia* and Gilbert's whistler *Pachycephala inornata.*

Recovery Plans have been prepared for swift parrot, regent honeyeater and yellow-bellied glider. A Priorities Action Statement has been prepared that sets out recovery actions for the other threatened fauna recorded in the reserves, guiding relevant aspects of reserve management.

3.4 ABORIGINAL HERITAGE

Aboriginal communities have an association 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 reserves are located in an area once occupied by the Wiradjuri People. Traditional uses, such as hunting, gathering and ceremony, would have taken place over the landscape including the areas now gazetted as nature reserves. The area of the Young and Cowra Local Aboriginal Land Councils encompasses the planning area.

Aboriginal heritage survey of the area conducted in 2002/03, in consultation with members of the local community identified 35 sites within the reserves including quarry sites, artefact scatters, scarred trees and possible grinding grooves. Three artefact scatters (one in Dananbilla Nature Reserve and two in Illunie Nature Reserve) were considered to be of potentially high significance, as it is possible they were quarry sites. A shelter with artefacts in Illunie Nature Reserve was also considered to have significance due to the rarity of this type of site in the area.

3.5 HISTORIC HERITAGE

The European presence in the local area began with pastoralism, probably commencing after the Crown Lands Occupation Act was passed in 1836. Large runs, such as the ‘Bang Bang’ run of 30,000 acres (12,000ha) on which Koorawatha Nature Reserve is located, were established in the area. The range in the vicinity of Dananbilla Nature Reserve formed the eastern boundary of the ‘Crowther’ and ‘Bendick Murrell’ runs. Illunie Nature Reserve is located on the southern extent of the original ‘Illunie’ run, now known as ‘Karoopa’ (Shumack, undated).

With the Robertson Land Act in 1861, land was opened up to smaller scale settlement, and much land was cleared and sometimes cultivated. Other enterprises commenced in the area, such as dairying and timber milling. In 1896, a sawmill operated near Koorawatha on the Illunie Range. Sandstone was also quarried from the range. These activities continued for many years in various locations. A sawmill is known to have operated on ‘Fernhill’ (now Illunie Nature Reserve) through the 1930s and 1940s with white box and cypress cut from the property.

In 1913 a weir on Bang Bang Creek in the Koorawatha Falls Reserve was constructed for the purposes of providing water for the railway. The water ran through wooden pipes from the weir to the station, passing through Koorawatha Nature Reserve.

A number of sites associated with past agricultural occupation of these lands are still evident. These include a house, shearing shed and farm complex in Koorawatha Nature Reserve; the remains of small structures and yards in Dananbilla Nature Reserve; foundations, old gardens and exotic trees in Illunie Nature Reserve and a rabbiters’ hut in Gungewalla Nature Reserve. The pipeline from the Koorawatha Weir is still visible as it passes through the reserve on a narrow easement.

3.6 EDUCATION, RECREATION AND RESEARCH VALUES

Public use of the reserves is generally low, though Koorawatha Nature Reserve is used more frequently to gain access to the Koorawatha Falls Reserve, administered by Cowra Council. Some use of the reserves by bushwalkers and by bird watching groups occurs.

A series of floristic survey plots and monitoring transects have been established in Dananbilla, Koorawatha and Illunie Nature Reserves. These provide a basis for monitoring the responses of reserve vegetation to fire and rehabilitation works. In addition, Landscape Function Analysis transects, assessing ground cover, water movement and infiltration rates, have been established to monitor these landscape processes and their impacts on ecosystem functions. Fuel monitoring plots have also been installed in all of the reserves.

4. THREATS TO RESERVE VALUES

4.1 PEST SPECIES

The reserves incorporate areas once subject to agricultural practices such as cultivation and grazing. Previously cultivated areas and fertile valley floors, in particular, have a high proportion of exotic species such as Paterson's curse *Echium plantagineum* and St John's wort *Hypericum perforatum.* Sandy footslopes with poor native grass cover in recent additions to Dananbilla and Koorawatha Nature Reserves contain localised infestations of spiny burr grass *Cenchrus pauciflorus.* Some moist seepage lines in Illunie Nature Reserve are infested with sweet vernal grass *Anthroxanthum odoratum.*

Paterson's curse, St John's wort and cape weed *Arctotheca calendula* occur in small patches throughout the reserves in old sheep camps, and since the drought widespread infestations of the annual cranesbill *Erodium* sp. have been observed. Skeleton weed *Chondrilla juncea* is also common in the recent addition to Dananbilla Nature Reserve. It is expected that the abundance of these weeds will reduce as ground cover increases and soil fertility drops in response to the cessation of grazing.

Perennial introduced pasture grasses such as cocksfoot *Dactylis glomerata* and phalaris *Phalaris* sp. have become established in limited areas of the reserves, especially in areas with higher fertility and deeper soils. These grasses have a high potential to invade grassy ecosystems, particularly where grazing has reduced native perennial grass abundance.

Woody weeds such as peppercorn *Schinus molle* and African boxthorn *Lycium ferocissimum* are common on the western fringe of Koorawatha Nature Reserve, while sweet briar *Rosa rubiginosa* is widespread in the recent addition to Dananbilla Nature Reserve.

Pest animals that have been recorded include goats, deer, rabbits, cats and foxes. All utilise the reserves as part of the broader landscape. Goats occur in moderate numbers and may impact on quoll den sites, as well as grazing native plant species. Control programs conducted in recent years have significantly reduced populations of goats in the reserves and surrounding freehold land. Foxes and cats also pose threats to native fauna, but as they are established across the broader landscape, control at a reserve level is difficult. NPWS contributes to annual control of foxes off reserve each year.

Pest fauna are not regarded as a significant threat to reserve values due to the success of control programs, and the relatively small pest numbers within the reserves.

4.2 FIRE MANAGEMENT

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.

The primary fire management objectives of the 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 (NPWS, 2005). The NPWS uses

a zoning system for bush management that is compatible with the zoning used by the South West Slopes Zone Bush Fire Management Committee (BFMC) in its bushfire risk management plan.

Fire management strategies for these reserves are included in this plan of management. They will be supported by a separate fire operations map.

The northern section of Dananbilla Nature Reserve, Gungewalla Nature Reserve and much of Illunie Nature Reserve are reported to have burnt in 1944. Since then, recorded fires have been small in extent. Part of Gungewalla Nature Reserve burnt in a wildfire in 1992. Since 2000, Dananbilla has experienced two small fires (<1ha), one caused by lightning and the other escaped from a stubble burn. In the same period Illunie Nature Reserve also experienced two small fires, one caused by arson (approximately 3ha), and the other a stubble burn escape (<1ha). Koorawatha Nature reserve was affected by an escaped stubble burn in 2006, burning less than 1ha of reserve.

The reserves are located within a largely rural landscape, with few assets located close to reserve boundaries. The village of Koorawatha lies approximately one kilometre to the west of the Koorawatha Nature Reserve, and under normal fire weather conditions is unlikely to be affected by fires leaving the reserve.

Fuel sampling of all reserves was undertaken in 2004, verifying and expanding on data collected in a previous survey of Dananbilla Nature Reserve in 1998. These show that fuel loads within the reserves are stable, having reached maximum levels. Average fuel levels for each reserve for total litter, grass and shrub fuels were:

Reserve	Size	Range of fuel loads (t/ha)	Average fuel loads (t/ha)
Gungewalla	142ha	13.0–14.0 (3 sites)	13.6
Illunie	723ha	9.2–14.6 (5 sites)	11.5
Dananbilla	2242ha	5.0–10.0 (5 sites)	7.6
Koorawatha	1105ha	8.4–10.9 (5 sites)	9.0

NPWS has assessed the reserves for fire management planning and has zoned the reserves as land management zone (LMZ). Apart from the over-riding legislative objective of protecting life and property, the primary fire management objectives for a land management zone are to conserve biodiversity and protect cultural heritage. The reserves have been designated as a LMZ because they are not adjacent to built assets which would be exposed to a high level of bushfire risk and do not have the history of bushfire ignitions or known areas of high bushfire potential.

However, the reserve fuel loads are consistent with more stringent Rural Fire Service guidelines for strategic fire management zones, which lie generally within 500 m of assets. These broadly recommend that fuel loadings be maintained at between eight and fifteen tonnes per hectare for 60-80% of strategic fire management zones.

Field survey of Dananbilla and Koorawatha Nature Reserves (Doherty, 2006) did not detect any obvious differences in biodiversity between the areas burnt in the 1940's and those that did not. Most plants in the reserves re-sprout after fire or drought, and are relatively resilient to a broad range of fire regimes, although they also need to recruit from seedlings from time to time. A small number of species in the reserves are killed by fire but generally only recruit vigorously after a fire event, and their abundance may gradually reduce without fire-triggered germination events. However, as ongoing

germination without fire has been observed in most of these species within the reserves, risk of this is low.

The adaptability of plant species to fire can be grouped on the basis of vegetation communities, and thresholds for fire frequency established as a guide to maintaining species diversity. The thresholds also provide for soil nutrient recovery between burns, development of cover to reduce erosion and the maintenance of suitable faunal habitat. It has been estimated that vegetation in this area should not generally be burnt more frequently than 20 years, or less frequently than every 120 years. However, given the lack of knowledge on ecosystem functioning without fire, the upper limits are untested.

4.3 ISOLATION AND FRAGMENTATION

The area surrounding the reserves has been extensively cleared, with less than 10% of natural vegetation remaining, which has resulted in a high loss of biodiversity, landscape function and fragmentation of habitat in the region. Long-term conservation of biodiversity depends upon the protection, enhancement and connection of remaining habitat across the landscape, incorporating vegetation remnants on both public and private lands. Nearby vegetated areas contribute to the habitat values of the reserve and provide ecological corridors to other forested areas. Maintaining the integrity of the habitat within the reserves and, where possible, linking this to nearby areas of native vegetation is important in ensuring long term viability of the reserve's biological values.

Within the reserve areas, fragmentation is present as a result of previous clearing and agricultural activities. Some previously cleared areas are covered with dense cypress pine or Blakely's red gum regrowth. Other more extensive cleared areas in Illunie and Dananbilla Nature Reserve also have the potential to develop dense regrowth stands as they revegetate following removal of grazing.

The density of saplings within these stands is higher than would normally occur in native woodland and open forest, due to the lack of competition against germinant seedlings from mature trees. The high nutrient demand within such thickets may inhibit growth of trees, and the progression towards a more open forest may take many years. Branch hollows cannot develop until the trees mature, and this, combined with the dense structure of the vegetation will potentially limit the suitability of the habitat for fauna over an extended period, unless actively managed.

4.4 CLIMATE CHANGE

Climate change has been listed as a key threatening process under the *Threatened Species Conservation Act 1995.*

Projections of future changes in climate for NSW include higher temperatures, increasing sea levels and water temperatures, elevated CO_2, more intense but possibly reduced annual average rainfall, increased temperature extremes and higher evaporative demand. Seasonal rainfall changes, with slightly higher summer rainfall, slightly lower autumn and spring rainfall and significantly lower winter rainfall being predicted.

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.

Individual species have two possible survival mechanisms in response to changes in climate – adaptation or migration. The rate and extent of predicted warming, however, is likely to exceed the ecological tolerances of many species. And the ability of species to shift their range, may be compromised by loss, fragmentation and isolation of natural habitats. Evolutionary responses are also likely to be too slow for most species to adapt in the short term.

Shifts in distribution, behavioural changes, and local extinction are therefore more likely responses. There is also increasing evidence of earlier flowering and fruiting in plants, and earlier reproduction in amphibian and birds in response to warmer temperatures (Department of Environment and Heritage 2007).

The direct impacts of climate change on species and ecosystems may include:

- Range shifts and species movement towards cooler latitudes or higher elevations
- Extinctions of local populations along range boundaries
- Changes in productivity and nutrient cycling within ecosystems, due to a combination of climate change and increasing carbon dioxide levels
- Increasing invasion by opportunistic, weedy or highly mobile species, especially into sites where local populations of existing species are declining
- Increasing threat to freshwater ecosystems through decreasing water flows and changes in water temperature and chemistry, and
- Progressive decoupling of species interactions (for example plants and pollinators).

Adjusting our management of the environment through 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.

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Personal Communications

Keith Butt, local grazier

6. MANAGEMENT STRATEGIES AND ACTIONS

Current Situation	Desired Outcomes	Management Strategies / Actions	Priority
Soil and water conservation			
Many grassland areas are sparsely vegetated, permitting high runoff and erosion from only moderate rain events. Areas adjoining, or covered by dense regrowth timber are also only sparsely grassed.	Soil erosion is minimised.	Undertake all works in a manner that minimises erosion and water pollution.	High
	Water quality and health of reserve streams is improved.	Use coarse woody litter to create porous weirs that will slow overland water flow and trap soil and organic matter in previously agricultural areas.	Low
Minor active erosion is occurring in some drainage lines in the reserves. Some erosion gullies in Koorawatha, Dananbilla and Illunie Nature Reserves have been stabilised in recent years.	Improve natural water flows.	Monitor the regrowth of cypress pine and eucalypts. Undertake sequential, monitored thinning of these areas to enable ground cover to increase and monitor the response.	Low
Deep volcanic derived soils become waterlogged rapidly, particularly through the winter and spring. Vehicle use off formed tracks at these times is detrimental.		Monitor erosion and stabilise as required.	Medium
		Avoid driving off hardened trails and utilise quad bikes for essential management operations when the soil is moist.	Medium
A number of dams are located in the reserves, with a particularly high density in Illunie Nature Reserve and in the recent additions to Dananbilla Nature Reserve. These dams impede natural water flows to downstream creek systems, both on and off reserve. Alteration of natural water flows has been identified as a key threatening process.		Reduce size of and/or remove dams not required for fire fighting operations.	Medium

Current Situation	Desired Outcomes	Management Strategies / Actions	Priority
Native plant and animal conservation Extensive plant survey has been undertaken in the reserves. The reserves protect areas of the white box- yellow box – Blakelys red gum woodland endangered ecological community, box - ironbark woodland and open forest. A number of threatened fauna have been recorded in the reserves, including the yellow-bellied glider, squirrel glider, large-footed myotis, spotted-tailed quoll, superb parrot, brown treecreeper, diamond firetail, turquoise parrot, hooded robin, speckled warbler and swift parrot. Some previously cleared areas in the reserves are covered with dense cypress pine and Blakely's red gum regrowth. More extensive areas in Illunie and Dananbilla Nature Reserves, in particular, have the potential to develop dense regrowth thickets now stock grazing has ceased. Extensive areas of regrowth are known to limit habitat quality for fauna. Areas modified by previous grazing practices and, in particular, previously cultivated lands have a reduced proportion of native species in the ground layer.	All native plant and animal species and communities are conserved. Floristic and structural diversity are restored in modified areas. Habitat quality for threatened species is maintained or enhanced.	Continue to build onto the protected area network as opportunities arise, focussing on protecting poorly represented ecosystems, expanding reserve cores and developing effective linkages between reserves. Mechanisms include possible land purchase and the development of co-operative conservation initiatives with interested landholders. Monitor the composition of the ground layer in response to the removal of grazing, weed treatment control and other management activities. Trial and apply active management techniques such as burning, slashing, application of sugar to reduce soil fertility, with replanting programs to encourage native species establishment in modified agricultural lands, where required. Monitor the regrowth of cypress and eucalypts. Commence a sequential, monitored programme thinning of selected areas of regrowth to develop suitable habitat for the threatened fauna utilising the reserves. Implement habitat rehabilitation programs, consistent with the provisions of the Recovery Plans and Priority Action Statements for the threatened species listed. Liaise with neighbours to encourage the retention and appropriate management of key habitat and corridors	Medium Low Low Low Medium Low

Current Situation	Desired Outcomes	Management Strategies / Actions	Priority
The reserves support large numbers of eastern grey kangaroos, as the combination of broken shelter, otherwise un-grazed native grasses and artificial water provides ideal habitat. Kangaroos also utilise the numerous water and food resources across the broader landscape. Grazing pressure of kangaroos, particularly during extended dry periods, is adversely affecting the grassy ground-layer and potentially impacting on habitat suitability for other native fauna.	Maintain floristic and structural diversity.	adjacent to the park. Fence identified fire dams to reduce grazing impacts in adjoining areas. Monitor impacts on dam fencing on kangaroo numbers, ground-layer health and diversity. Actively manage kangaroo numbers in accordance with ecological needs, the NPW Act and environmental approvals.	Medium Medium Medium

Current Situation	Desired Outcomes	Management Strategies / Actions	Priority
Cultural heritage 35 sites have been recorded within the reserves, including quarry sites, artefact scatters, scarred trees and possible grinding grooves. Three artefact scatters (one in Dananbilla Nature Reserve and two in Illunie Nature Reserve) were considered to be of potentially high significance, as they may have been quarries. A shelter with artefacts in Illunie Nature Reserve was also considered to have significance due to the rarity of this type of site in the area. A number of historic places associated with past agricultural occupation of these lands have been recorded and assessed as having low significance. These include a 1940s pastoral complex of fibro house, orchard, shearing shed and yards at Koorawatha Nature Reserve.	Cultural features are conserved and managed in accordance with their significance.	Precede all ground disturbance work by a check for cultural features. Any works undertaken will incorporate appropriate conservation measures to mitigate impacts on cultural heritage. Consult and involve the Young and Cowra Local Aboriginal Land Councils and other Aboriginal stakeholders in all aspects of management of Aboriginal sites, places and values. Management operations will be conducted in a manner that ensures that remnants of historic places remain as indicators of past use. Active conservation works will not be undertaken except at the Koorawatha pastoral complex. Maintain the Koorawatha house as basic accommodation for management purposes. Assess the cost/benefit of the house every 3 years and if this use is not cost effective, review options to demolish the house, consistent with DECC policy. Retain the shearing shed, yards and other elements of the Koorawatha pastoral complex.	High High Medium High Medium Medium

Current Situation	Desired Outcomes	Management Strategies / Actions	Priority
Introduced species Weeds present in the reserves include St John's wort, Paterson's curse, skeleton weed, sweet briar, cranesbill, phalaris and cocksfoot. The exotic grasses in particular have a high potential to invade grassy ecosystems and reduce the abundance of native species. Annual weed control programs have been implemented in disturbed areas since reservation. Pest animals include goats, deer, rabbits, cats and foxes.	The impact of introduced species on native species and neighbouring lands is minimised.	Control introduced plant and animal species. Priority will be given to the control of St John's wort, Paterson's curse, sweet briar and exotic perennial grasses. Monitor noxious and significant environmental weeds. Treat any new outbreaks where possible. Implement goat control programs as required, in co-operation with landholders and Young Rural Lands Protection Board. Participate in co-operative fox control programs. Continue routine control of rabbits.	High Medium Medium Medium Medium

Current Situation	Desired Outcomes	Management Strategies / Actions	Priority
Fire management The reserves are located within a matrix of cleared and timbered lands. Two houses are located within 150m of the eastern side of Illunie Nature Reserve. Koorawatha village is located more than one kilometre to the west of Koorawatha Nature Reserve. Historic assets in the reserves are vulnerable to fire. No widespread wildfires have been recorded in the reserves since 1944, though numerous small fires have occurred. Since gazettal, trails and access routes have been upgraded. Where practical, perimeter trails have been constructed to follow the reserve boundaries. It is estimated that in these vegetation communities consecutive fires should not be applied less than 20 years apart. Widespread, high intensity fires have the potential to destroy food, perching and nesting resources in the reserve.	Persons and property are protected from bushfire. Cultural features are protected from damage by fire. Fire regimes are appropriate for conservation of plant and animal communities.	Participate in the South West Slopes Zone Bush Fire Management Committee. Maintain co-ordination and cooperation with the Rural Fire Service, volunteer brigades and neighbours with regard to fuel management and fire suppression. Undertake any prescribed burning activities identified in conjunction with the Bush Fire Management Committee for property protection. Prepare a fire operations map for the reserves, including guidelines for protection of cultural sites. Maintain perimeter trails and other strategic routes throughout the reserves. Fire management guidelines for maintaining the biodiversity values of the reserve include: • Contain fires to as small an area as possible, • Maintain a range of fire age classes in the reserves. • Monitor the germination and attrition rates of fire-sensitive plant species. • Monitor biodiversity in the reserve and adapt fire management accordingly.	High High High High High Medium Low Low

Current Situation	Desired Outcomes	Management Strategies / Actions	Priority
Visitor use The reserves have little public use, except for Koorawatha Nature Reserve which is utilised by visitors accessing the adjoining Koorawatha Falls Reserve. The reserves have limited public access from public roads. Koorawatha Nature Reserve thus provides an important resource for the local community to enjoy, appreciate and understand the natural environment, and in particular the values of grassy woodland. An interpretive sign describing the values of the reserve has been installed in Koorawatha Nature Reserve. Trail bike riders occasionally leave the public access road through Koorawatha Nature Reserve. This use is inconsistent with the NPWS vehicle access policy, and damages ground cover.	The local community is aware of the significance of the area and of management programs. Visitor use is ecologically sustainable.	Permit day walks, picnics (no facilities will be provided and no fires permitted) and educational visits, subject to limits on numbers and other conditions, if necessary to minimise impacts. Exclude vehicular access except for essential management requirements of the reserve. Prohibit camping, trailbike riding and horse riding. Monitor levels and impacts of use. Close and rehabilitate any trailbike tracks as soon as they are identified. Support this process with ongoing public education and law enforcement activities as required.	Medium High High Low Medium

Current Situation	Desired Outcomes	Management Strategies / Actions	Priority
Research Recent research into the flora and fauna of the reserves provides a basis for informed management. A monitoring program has been established to enable monitoring of changes in the diversity and abundance of flora species in response to environmental and management factors. Fuel monitoring is undertaken. Monitoring of ground cover, landscape water flows and storage patterns has commenced using Landscape Function Analysis. This provides a framework to restore ecosystem processes within the reserves.	Research enhances the management information base and has minimal environmental impact.	Continue to monitor the abundance and diversity of significant understorey species. Encourage research into: • fire history • groundlayer rehabilitation • threatened fauna • dynamics of drainage lines and erosion gullies Continue to monitor fuel loads every 7-10 years or following wildfire events. Continue to assess ground cover, water flows and storage patterns across the landscape to monitor impacts of kangaroo grazing in the reserve.	Medium Medium Medium Medium

Current Situation	Desired Outcomes	Management Strategies / Actions	Priority
Management operations			
A network of trails and routes is located within the reserves, established by previous landholders. This trail system has been rationalised and some trails removed. Key trails, including those along the perimeter of the reserves, have been maintained and re-routed where necessary to improve drainage.	Management facilities adequately serve management needs and have acceptable impact.	Trail routes will be formalised and maintained to meet management needs. Minor re-routing to better drained locations will be undertaken following assessment during extended wet periods.	High
		New trails may be established to meet essential management needs. Obsolete trails will be closed and rehabilitated.	High
Additions to the reserve system have included extensive internal fencing. These fences have been gradually removed, except from the ungazetted addition to Dananbilla Nature Reserve.		Internal fences in future additions to the reserve system will be removed.	Low
A 1990s weekender shack and associated sheds were acquired as part of Illunie Nature Reserve. A steel carport and small garden shed have been retained for management operations. The weekender and other superfluous infrastructure have been removed.			

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.