Technical Paper 1

TERRESTRIAL ECOLOGY

Keepit Dam Upgrade Terrestrial Biodiversity Assessment

November 2007

State Water Corporation

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1. Introduction

Parsons Brinckerhoff was commissioned by State Water Corporation (State Water) to prepare a terrestrial biodiversity assessment of the proposed upgrade of Keepit Dam (the proposal).

The Keepit Dam Upgrade is being assessed under Part 3A of the *Environmental Planning and Assessment Act 1979*. A referral under the *Environment Protection and Biodiversity Conservation Act 1999* has been prepared for this project and submitted to the Commonwealth Department of the Environment and Heritage.

An aquatic assessment of the proposal has also been prepared and is provided in *Technical paper 4*.

1.1 Study area

Keepit Dam is situated between the townships of Gunnedah and Tamworth in the north-east of New South Wales (NSW). It is located on the Namoi River, 13 kilometres upstream of its confluence with the Peel River. The study area spans two local government areas: Gunnedah Shire and Tamworth Regional.

The study area comprises construction areas, including spoil disposal locations located within land owned by the NSW Government and managed by Lake Keepit State Park and State Water, and upstream and downstream areas to the confluence of the Namoi and Peel Rivers which would be inundated during a very large to extreme flood event.

The study area is shown in *Figure 1-1*.

1.2 The proposal

The Keepit Dam Upgrade is a proposal to upgrade Keepit Dam to ensure it is capable of withstanding extreme natural events including extreme floods and earthquakes. The upgrade is being proposed by State Water (the proponent) to meet the safety requirements of the NSW Dams Safety Committee.

State Water is seeking concept approval for three options for upgrading the safety of Keepit Dam. The three options all propose raising the main and subsidiary dam walls and additional spillways and saddle dams. All three options meet the safety requirements of the NSW Dams Safety Committee.

The Keepit Dam Upgrade does not include a change to the full supply level of the dam or a change to dam operation for high frequency floods. The upgrade would only result in a change to dam operations for large to extreme floods with a frequency of occurrence of approximately 1:2,400 annual exceedance probability or less.

Subject to planning approval, the proposal would commence construction in 2008

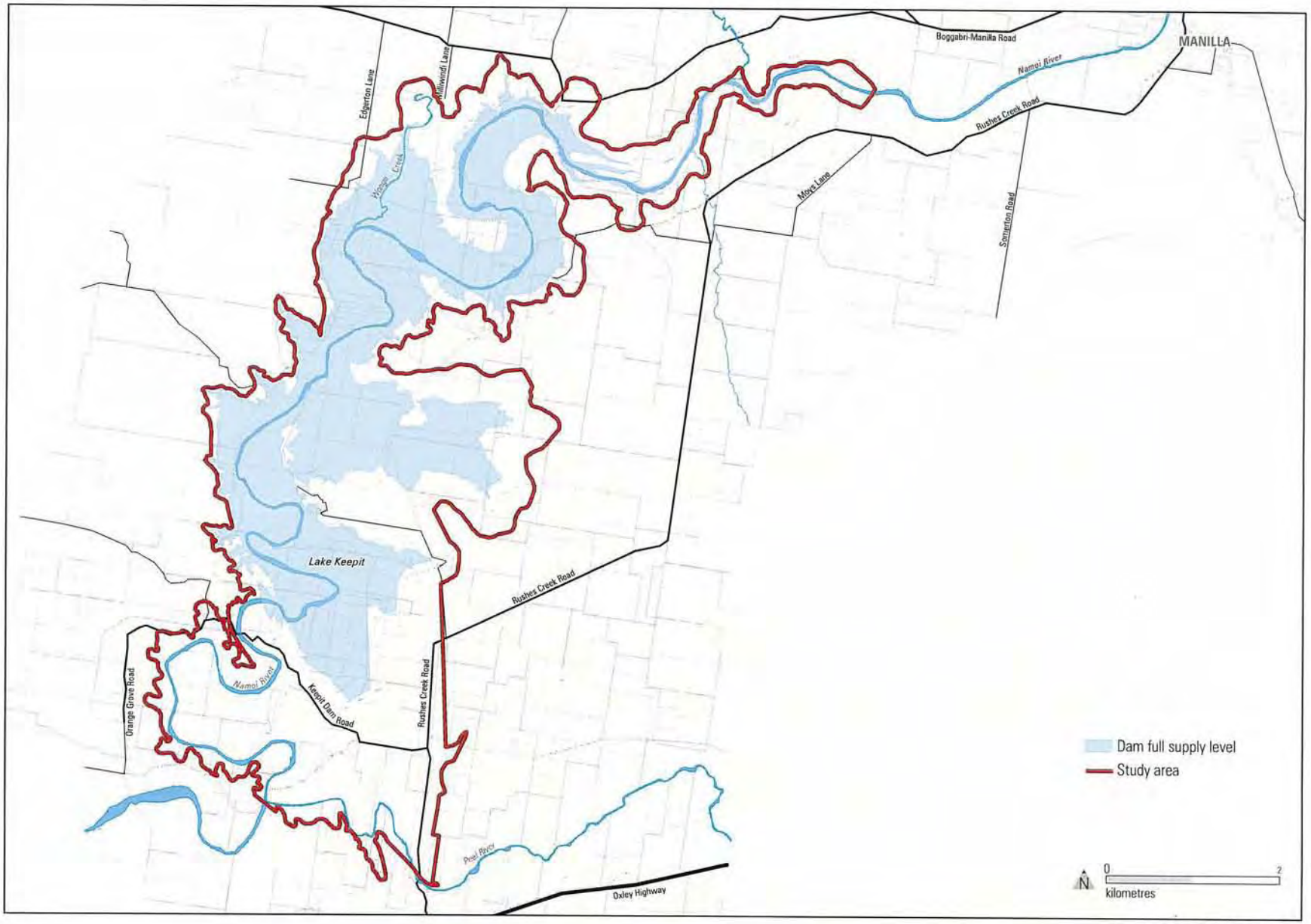


Figure 1-1 **The study area**

1.3 Assessment scope, aims and objectives

The draft *Guidelines for Threatened Species Assessment* (Department of Environment and Conservation 2005) state that the objective of the assessment process is to provide information to enable decision makers to ensure that developments deliver the following environmental outcomes:

- maintain or improve biodiversity values (i.e. there is no net impact on threatened species or native vegetation)
- conserve biological diversity and promote ecologically sustainable development
- protect areas of high conservation value (including areas of critical habitat)
- prevent the extinction of threatened species
- protect the long-term viability of local populations of a species, population or ecological community
- protect aspects of the environment that are matters of national environmental significance.

With these objectives in mind, the aims of this technical paper are to:

- carry out on-ground confirmation of previous vegetation mapping, in particular to verify the presence of White Box Yellow Box Blakely's Red Gum Woodland (Grassy White Box Woodland), which is a Threatened ecological community listed under both the *Threatened Species Conservation Act 1995* (Endangered) and the *Environment Protection and Biodiversity Conservation Act 1999* (Critically Endangered)
- determine and describe the general characteristics and condition of the vegetation communities and flora and fauna habitats in the study area
- determine the occurrence or likelihood of occurrence of Threatened species listed under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999* in the study area
- provide information and compare the potential impacts of the proposed construction and operation of the three dam safety upgrade options on terrestrial biodiversity, particularly on critical habitats and Threatened species, populations, ecological communities and their habitats
- propose further investigations and/or amelioration measures to mitigate impacts on the ecological values of the study area.

2. Methods

The assessment included desk-based searches of databases and historical records as well as field survey within the study area. The assessment followed the draft *Guidelines for Threatened Species Assessment* (Department of Environment and Conservation 2005).

2.1 Personnel

The contributors to the preparation of this report, their qualifications and roles are listed in *Table 2-1.*

All work was carried out under the appropriate licences including a scientific licence as required under Clause 22 of the National Parks and Wildlife Regulations 2002 and Section 132C of the *National Parks and Wildlife Act 1974* as well as animal research authority issued by the Department of Primary Industries (Agriculture).

Table 2-1 Contributors and their roles

Name	Qualification	Role
Selga Harrington	BSc (Hons)	Ecologist - field surveys and report preparation
Alex Fraser	BAppSc (Hons)	Zoologist - field surveys and report preparation
Nick Corkish	BForSc	Ecologist - field surveys

2.2 Nomenclature

Names of plants used in this document follow Harden (Harden 1992, 1993, 2000, 2002) with updates from PlantNet (Royal Botanic Gardens 2006). Scientific names are used in this report for species of plant. Scientific and common names (where available) are provided in plant lists in *Attachments A* and *B*.

Names of vegetation communities used in this report are based on the dominant species and structure of the community. Where practical the names follow those used in the existing vegetation mapping or Threatened community listings under the *Threatened Species Conservation Act 1995* and/or the *Environment Protection and Biodiversity Conservation Act 1999*.

Names of vertebrates follow the Census of Australian Vertebrates (CAVS) database maintained by the Department of the Environment and Heritage (Department of the Environment and Heritage 2006a). Common names are used in the report for species of animal. Scientific names are included in species lists found in *Attachments C* and *D*.

2.3 Definitions

For the purpose of this report the following definitions apply:

Subject site: the construction areas proposed for the dam upgrade works.

Study area: the study area includes the subject site defined above and additional areas that could potentially be affected by the proposal either directly or indirectly including areas potentially affected by upstream and downstream inundation during very large to extreme flood events.

Locality: the area within a 30 kilometre radius of the study site.

Region: a bioregion defined in a national system of bioregionalisation. For this study this is the Nandewar bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway & Cresswell 1995).

2.4 Database searches and literature reviews

Records of Threatened species were obtained from the Department of Environment and Conservation's Atlas of NSW Wildlife (Department of Environment and Conservation 2006a) within the locality, using the Boggabri and Manilla 1:100,000 map sheets. Details of Threatened species and communities and migratory species listed pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* that could potentially occur within the project locality were obtained using the Department of the Environment and Heritage's Protected Matters Search Tool (Department of the Environment and Heritage 2006b). The accuracy of these databases is outlined in *Attachment E*.

2.5 Surveys

Surveys of the study area were carried out between 18 and 22 July, 2005 and between 29 May and 2 June, 2006.

Field inspections were carried out to assess primarily the extent and condition of vegetation communities and potential flora and fauna habitat, especially for Threatened species. Sites surveyed included the proposed construction and stockpile zones and areas potentially affected by temporary upstream inundation and downstream flooding during very large to extreme flood events. Given the size of the areas potentially affected by upstream and downstream inundation during very large to extreme flood events, a habitat-based approach was taken in these areas.

2.5.1 Vegetation mapping

Existing vegetation mapping (Department of Land and Water Conservation 2002; EcoPro 2003) was ground truthed during general flora and fauna surveys including random meander surveys, fauna surveys and while driving or walking along tracks or from a boat on Lake Keepit.

2.5.2 Condition of vegetation communities

The quality of vegetation was assessed using parameters such as intactness, diversity, history of disturbance, weed invasion and health.

Three categories were used to describe the condition of vegetation communities:

- Good: Vegetation still retains the species complement and structural characteristics of the pre-European equivalent. Such vegetation has usually changed very little over time and displays resilience to weed invasion due to intact ground cover, shrub and canopy layers.
- Medium: Vegetation generally still retains its structural integrity but has been disturbed and has lost some component of its original species complement. Weed invasion can be significant in such remnants.
- Poor: Vegetation that has lost most of its species and is significantly modified structurally. Often such areas now have a discontinuous canopy of the original tree cover, very few shrubs. Exotic species, such as introduced pasture grasses or weeds, replace much of the indigenous ground cover or are co dominant with the original indigenous species.

2.5.3 Species of plant

Species of plants in the study area were assessed and recorded using the random meander technique (Cropper 1993), where the recorder walks in a random manner throughout the area, recording all species seen. The time spent in each vegetation community is generally proportional to the size of the community and its species richness.

2.5.4 Fauna habitat

The fauna survey of the study area was based primarily on the habitats present with species of animal present recorded opportunistically during the habitat assessments. While recording Threatened species during surveys can confirm their presence in an area, a lack of Threatened species records cannot necessarily be used to argue the absence of the species from the site when suitable habitat is present. By the very nature of their rarity, Threatened species are often difficult to detect. Suitable habitat is therefore the most important factor to consider when determining the potential presence of Threatened species.

Fauna habitats were assessed by examining characteristics such as the structure and floristics of the canopy, understorey and ground vegetation. The structure and composition of the litter layer and other habitat attributes important for feeding, roosting and breeding. The following criteria were used to evaluate habitat values:

- Good: A full range of fauna habitat components are usually present (for example, old-growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.

- Moderate: Some fauna habitat components are often missing (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact although sometimes degraded.
- Poor: Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive past clearing.

2.5.5 Targeted fauna survey

Targeted fauna surveys were carried out as described below. The location of targeted fauna surveys are shown in *Figure 2-1*.

Call playback

Call playback was used to survey for Barking Owl, Masked Owl, Powerful Owl and Squirrel Glider using the methods of Kavanagh and Peake (1993) and Debus (1995). Call playback was done across the study area at various locations after dusk (refer *Figure 2-1* for locations). After an initial listening period of 10 to 15 minutes, a spotlight search for 10 minutes was completed to detect any animals in the immediate vicinity. Calls of the target species were then played intermittently for 5 minutes followed by a 10 minute listening period. After the calls were played, another 10 minutes of spotlighting and listening was carried out in the vicinity to check for birds and mammals attracted by the calls but not vocalising. Calls were broadcasted using a portable CD player amplified through a modified 15 watt megaphone.

Spotlighting

The objective of this survey technique was to target arboreal, flying and large ground-dwelling mammals as well as nocturnal reptiles and amphibians. Spotlighting was done on foot over four consecutive nights throughout the study area using two handheld 100 watt spotlights. Surveys were also undertaken from a slow-moving vehicle on one night using handheld 100 watt vari-beam spotlights (refer *Figure 2-1*). The speed of spotlighting surveys on foot was approximately 1 kilometre per hour. Areas spotlighted by car were done at a speed of less than 5 kilometres per hour. Surveys were concentrated on areas that contained suitable habitat for nocturnal species such as vegetation that formed parts of larger remnants, or fragmented habitats located nearby. Any sighted animal was identified to species.

Microchiropteran bat surveys

Ultrasonic Anabat Bat detection (Anabat II Z-CAIM- Titley Electronics, Ballina) was used to record and identify the echolocation calls of microchiropteran bats foraging across eight sites in the study area (refer *Figure 2-1*). All Anabat Bat detectors were attached to a time delay switch with the potential to record bat vocalisations throughout the full night, with the recording starting at dusk. Calls recorded were analysed by Ray Williams of Ecotone Pty Ltd for species identification.

Diurnal bird surveys

Birds were observed in the study area using fixed point surveys at fourteen locations (refer *Figure 2-1*). All birds observed within a 20 minute period from these fixed points were recorded. Some bird surveys were done at the same location both in 2005 and 2006 (refer *Table 2-2*).

Incidental sightings

Opportunistic recordings of species were made through observation methods such as incidental sightings, identifying bird calls and by sighting indirect evidence of species presence such as scats, nests, roost sites, feathers, hair, tracks, diggings and feeding marks on and around trees.

Koala habitat assessment

Koala have been previously recorded 10 kilometres south of Keepit Dam along the Namoi River in 2002 (Department of Environment and Conservation 2006b). A general habitat based assessment of the study area was undertaken based on the presence of Koala feed trees as listed on Schedule 2 of the State Environmental Planning Policy - 44 Koala Habitat Protection as well as those known to be used by Koalas and listed in the daft Department of Environment and Conservation Koala recovery plan (NSW National Parks and Wildlife Service 2002a). This assessment was undertaken during the general habitat based assessment of the area as well as during targeted flora surveys. Potential Koala habitat was identified as areas of native vegetation where Koala feed trees constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. In areas of potential Koala habitat, field surveys included daytime scat, scratch and sighting searches and spotlighting to determine Koala activity.

2.6 Survey effort

A summary of all surveys undertaken is shown below in *Table 2-2* and illustrated in *Figure 2-1.*

Table 2-2 Total survey effort and location of survey

Date	Survey method	Effort	Site	Location description	Location (WGS 84)	
					Easting	Northing
18/7/05-22/7/05 29/5/06-2/4/06	Random meander vegetation surveys	72 hours		Across study area	-	-

Date	Survey method	Effort	Site	Location description	Location (WGS 84)	
					Easting	Northing
18/7/05-22/7/05 29/5/06-2/4/06	General fauna habitat assessment	60 hours		Various locations in each vegetation community type and other areas with different habitat features	-	-
31/5/06	Vegetation and habitat survey from boat on Lake Keepit	8 hours		Lake Keepit foreshores	-	-
18/7/05 & 29/5/06	Bird survey	40 minutes	H	Namoi River	259096	6582435
20/7/05 & 30/5/06	Bird survey	40 minutes	J	Peel River	260007	6581353
19/7/05 & 29/5/06	Bird survey	40 minutes	L	Confluence of the Namoi and Peel Rivers	260062	6580096
20/7/05 & 30/5/06	Bird survey	40 minutes	N	Western side of the main dam wall	260653	6579350
22/7/05 & 1/6/06	Bird survey	40 minutes	P	South of the sailing club	261173	6578351
22/7/05 & 28/5/06	Bird survey	40 minutes	Q	Lake Keepit Sport and Recreation Centre	264101	6577718
31/5/06	Bird survey	20 minutes	M	Borah Creek Reserve (upstream)	264213	6580167
1/6/06	Bird survey	20 minutes	F	North-western side of dam	260948	6585177
30/5/06	Bird survey	20 minutes	S	North-eastern upper reaches (Manilla Ski Gardens)	261427	6576564
2/6/06	Bird survey	20 minutes	D	Behind the caravan park	264298	6588287
29/5/06	Bird survey	20 minutes	E	Woodland near Peel/ Namoi confluence	261553	6587682

Date	Survey method	Effort	Site	Location description	Location (WGS 84)	
					Easting	Northing
21/7/05 & 1/6/06	Bird survey	40 minutes	A	Woodland remnant south of the subsidary dam wall	266282	6592959
22/7/05 & 28/5/06	Bird survey	40 minutes	B	Travelling stock reserve (north)	266240	6588287
18/7/05 & 2/6/06	Bird survey	40 minutes	R	Travelling stock reserve (south)	262261	6577525
29/5/06	Anabat[1]	1 night	A	Borah Creek Reserve (upstream)	266068	6592849
29/5/06	Anabat[1]	1 night	B	Western side of the main dam wall	266385	6588224
30/5/06	Anabat[1]	1 night	G	Sport and Recreation Centre land	260899	6584396
30/5/06	Anabat[1]	1 night	H	Upper Namoi River	259449	6582134
31/5/06	Anabat[1]	1 night	L	South of sailing club	259704	6580276
31/5/06	Anabat[1]	1 night	N	Travelling stock reserve (south)	260511	6579215
1/6/06	Anabat[1]	1 night	T	Namoi River (near Hakea)	264235	6576612
1/6/06	Anabat[1]	1 night	O	South of the subsidary dam wall	264019	6578525
29/5/06	Spotlighting	2 hours	H	Borah Creek Reserve (upstream)	260312	6581513
20/7/05 & 30/5/06	Spotlighting	4 hours	L	Namoi River	260821	6580199
22/7/05 & 31/5/06	Spotlighting	4 hours	K	Behind the sailing club and boat ramp	260688	6579700
22/7/05 & 31/5/06	Spotlighting	4 hours	J	Western side of the main dam wall	264266	6581953
19/7/05 & 1/6/06	Spotlighting	4 hours	I	Travelling stock reserve (north)	264168	6576478
28/7/05	Spotlighting	2 hours	B	Travelling stock reserve (south)	266387	6588331

Date	Survey method	Effort	Site	Location description	Location (WGS 84)	
					Easting	Northing
29/5/06	Spotlighting	2 hours	A	North-easter upper reaches (Manilla Ski Gardens)	266425	6593080
29/5/06	Call playback	1 hour	J	Borah Creek Reserve (upstream)	260089	6581232
29/5/06	Call playback	1 hour	L	North-easter upper reaches (Manilla Ski gardens)	260226	6579892
19/7/05 & 1/6/06	Call playback	2 hours	N	Travelling stock reserve (north)	260573	6579283
28/7/05	Call playback	1 hour	O	Travelling stock reserve (south)	264124	6578568
20/7/05 & 30/5/06	Call playback	2 hours	T	Namoi River	264180	6576594
22/7/05 & 31/5/06	Call playback	2 hours	I	Western side of the main dam wall	263944	6582666
19/7/05	Call playback	1 hour	C	Woodland near Peel/ Namoi confluence	265213	6588237

[1] Anabat set to record throughout the night

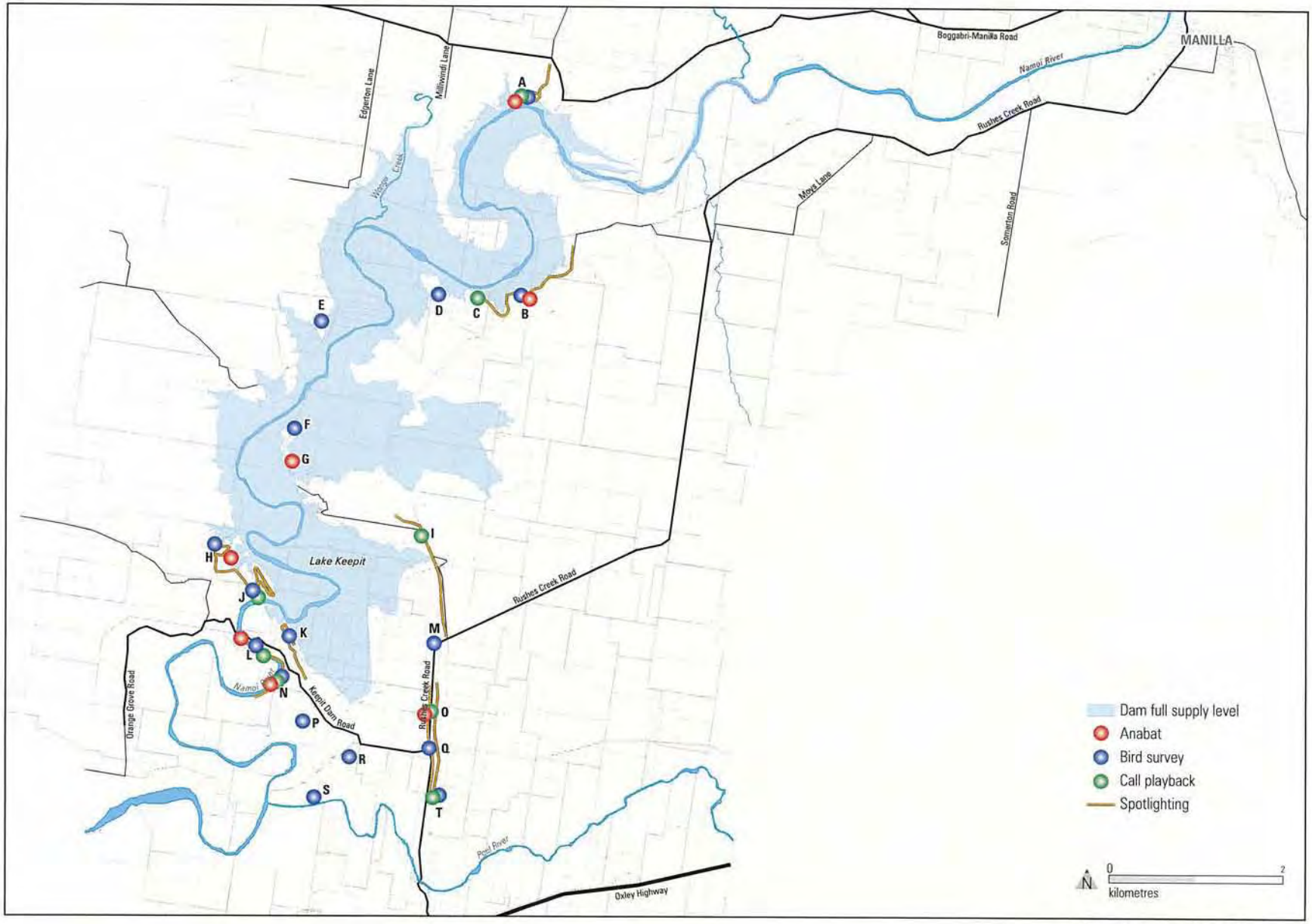


Figure 2-1 **Location of surveys**

2.7 Conservation significance

Assessment of the conservation significance of native terrestrial flora and fauna is done according to the hierarchy:

- national
- state
- regional
- local.

Meaningful comparisons of significance or value at a variety of scales rely on widely accepted criteria (for example, International Union for the Conservation of Nature 2001). The following criteria were used to assign the site to an appropriate conservation significance category.

National: This category includes matters dealt with under the *Environment Protection and Biodiversity Conservation Act 1999*, including:

- important areas of habitat for migratory species covered under international agreements to which Australia is a signatory, such as *the China Australian Migratory Bird Agreement* (CAMBA), *Japan Australian Migratory Bird Agreement* (JAMBA) and the *Bonn Convention on the Conservation of Migratory Species of Wild Animals*
- Ramsar Wetlands
- World Heritage properties that contain natural heritage considered to be of outstanding value to humanity as listed under the Convention Concerning the Protection of the World Cultural and Natural Heritage
- species populations or communities considered Vulnerable or Endangered and listed pursuant to the *Environment Protection and Biodiversity Conservation Act 1999*.

This category also includes:

- flora listed as Threatened and Rare in *Rare or Threatened Australian Plants* (Briggs & Leigh 1996)
- species listed as Endangered, Vulnerable or Rare in Australia in an action plan published by the Department of the Environment and Water Resources.

State: Remnant ecosystems containing populations of plant or animal species, or vegetation or animal communities considered Threatened in NSW, including species and communities listed pursuant to the *Threatened Species Conservation Act 1995*. This category also includes flora listed as poorly known in Australia in Rare or Threatened Australian Plants (Briggs & Leigh 1996).

Regional: There are no widely accepted criteria for regional significance in NSW. The state is divided into bioregions (Thackway & Cresswell 1995) and much of the listing of *Endangered Ecological Communities under the Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999* are based around these regions. NSW Catchment Management Authorities direct natural resource management within thirteen general catchments and include information on the extent of various vegetation communities. Also numerous published studies and vegetation mapping projects have indicated the importance of vegetation and species at various spatial scales.

Local: All remnant native vegetation and fauna habitat that does not fall into the categories above is considered to be of at least local significance as most of these areas have been reduced in extent since European settlement. The overall significance of the site on a local scale can take into consideration factors such as the size of remnants, degree of intactness and connectivity.

Potentially significant: Often the limitations of field methods, seasonal factors or time constraints make it impossible to confirm the presence of a significant species or population. However, the habitat of an area being investigated may closely match that used by the significant species in areas nearby where it is known to occur. In these circumstances, the level of significance that would otherwise apply is qualified by 'potential'. In addition, some species or communities may possess characteristics that make them eligible for listing as Threatened at either the national or state levels, although the listing has not taken place. Again, the level of significance for these species and communities is qualified by the term 'potential'.

2.8 Significance assessments

On 25 January 2006, the Minister for Planning authorised the submission of a Concept Plan for the proposed Keepit Dam Upgrade under Part 3A of the *Environmental Planning and Assessment Act 1979*.

For species, populations and communities listed under the *Threatened Species Conservation Act 1995* that have the potential to occur in the study area, the significance of impacts was assessed based on *Department of Environment and Conservation / Department of Primary Industries - Draft Guidelines for Threatened Species Assessment* (2005) (Appendix F). Under these guidelines, impacts would be more significant if:

- areas of high conservation value are affected
- individual animals and/or plants and/or subpopulations that are likely to be affected by the proposal play an important role in maintaining the long-term viability of the species, population or ecological community
- habitat features that are likely to be affected by the proposal play an important role in maintaining the long-term viability of the species, population or ecological community
- the duration of impacts are long-term
- the impacts are permanent and irreversible (Department of Environment and Conservation 2005).

For species listed under the *Environment Protection and Biodiversity Conservation Act 1999* significance assessment were completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of the Environment and Heritage 2006c).

For species listed under both Acts, the *Environment Protection and Biodiversity Conservation Act 1999* assessments were completed.

2.9 Limitations

Throughout the study area, varying degrees of uniformity of flora and fauna habitats are encountered. Hence no sampling technique can totally eliminate the possibility that a species is present in the study area (e.g. species of plant present in the seed bank). Some species of plant would not have been flowering at the time of the survey and would have been difficult to detect including Threatened species of grasses and orchids.

Field surveys were undertaken in August 2005 and May 2006 (i.e. colder months of the year) which would limit fauna activity and hence detection. Survey effort was also limited to areas accessible during the time of surveys.

As a result assessment of the site was largely habitat-based and a precautionary approach has been taken, with the presence of threatened species based on the suitability of habitat.

3. Existing environment

3.1 Vegetation communities

Vegetation communities within the study area are shown in *Figure 3-1.* This mapping is based on previous vegetation mapping (Department of Land and Water Conservation 2002; EcoPro 2003) and 'ground truthing' undertaken as part of the current surveys. These surveys identified five native vegetation communities:

- White Box Yellow Box Blakely's Red Gum Woodland
- Poplar Box Open Woodland
- River Red Gum Woodland
- Silver-leaved Ironbark Open Woodland
- Grassland.

Additionally, some parts of the study area were considered not natural in that they were highly modified by agricultural cropping or for other purposes (e.g. the main camping and recreation area at Lake Keepit State Park).

3.1.1 White Box Yellow Box Blakley's Red Gum Woodland and Derived Native Grasslands

White Box Yellow Box Blakley's Red Gum Woodland is listed as Endangered under Part 3 of Schedule 1 of the *Threatened Species Conservation Act 1995* (NSW Scientific Committee 2002) and as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Threatened Species Scientific Committee 2006).

The main occurrences of this community in the study area were to the north-west of the main dam wall and within Lake Keepit State Park on the south-eastern side of Lake Keepit. Smaller remnant areas of this community occur in the southern section of the study area (refer *Figure 3-1*). It occurred generally at altitudes above 340 metres, on flat to gentle lower slopes.

This community was generally open grassy woodland but in some cases was dominated by other species including White Cypress Pine. The condition of this vegetation community ranged from moderate to good in Lake Keepit State Park on the south-eastern side of Lake Keepit, to poor in the other areas mapped.

Four distinct associations of this community occurred within the study area. These are described in more detail below.

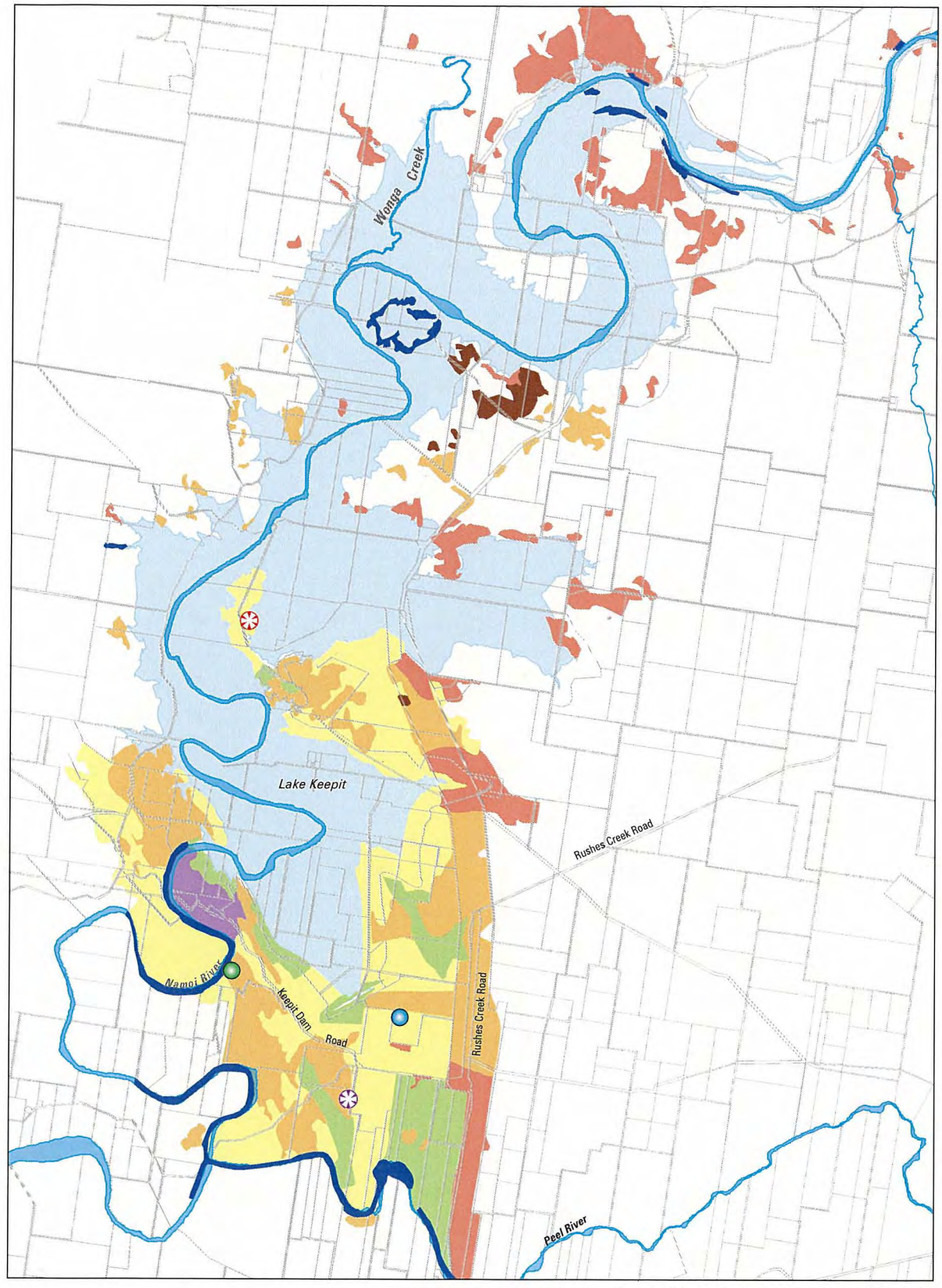


Figure 3-1 **Vegetation communities and threatened species within the study area**

White Box Woodland

White Box Woodland was the most common association within the study area (refer *Figure 3-1*). It is dominated by *Eucalyptus albens* (White Box), and generally lacks the regenerating eucalypt component. A mid-storey was usually absent or sparse with only occasional associated tree or shrubs of *Callitris glaucophylla* (White Cypress Pine), *Geijera parviflora* (Wilga) and *Notelaea microcarpa* (Native Olive). The understorey comprised native grasses, primarily *Bothriochloa macra*, *Austrostipa verticillata, Aristida ramosa and Dichanthium sericeum,* and forbs such as *Wahlenbergia communis.*

White Box–White Cypress Pine Open Woodland

White Box–White Cypress Pine Open Woodland appeared to occur mostly on mid to upper slopes and ridges and shallower soils and occurred extensively within the study area on the south and western sides of Lake Keepit, particularly within the proposed construction areas (refer *Figure 3-1*).

This association was dominated almost exclusively by *Callitris glaucophylla* (White Cypress Pine) in the highest stratum. Associated tree species include *Eucalyptus albens* (White Box), *E. blakelyi* (Blakely's Red Gum), *E. melanophloia* (Silver-leaved Ironbark) and *Angophora floribunda* (Rough-barked Apple). In some areas the eucalypt overstorey was absent and the upper stratum consisted purely of White Cypress Pine regrowth.

Most of this vegetation type appeared to have been cleared previously, except possibly of the remnant eucalypts, or otherwise heavily disturbed, with dense regrowth of White Cypress Pine since cessation of grazing or active management to suppress its regeneration (Department of Infrastructure Planning and Natural Resources 2004).

Despite dense cypress pine regrowth, the understorey contained a high diversity of native species, with few weeds recorded. This association was in moderate condition.

Blakely's Red Gum Open Woodland

One small area of Blakely's Red Gum Open Woodland was recorded, in the northern end of the Lake Keepit State Park on the eastern side of Lake Keepit. It was surrounded by and was similar structurally and floristically to White Box Open Woodland except that the overstorey was dominated by *Eucalyptus blakelyi* (Blakely's Red Gum). Prior to clearing, this community would have occurred more extensively on alluvial soils in moister sites, in a mosaic with White Box-dominated or Yellow Box-dominated woodland.

This association had a low level of weed invasion and was in moderate condition.

Yellow Box Open Woodland

Two small patches of Yellow Box Open Woodland were recorded on the Stratharlie Pastoral Company property between the Peel River and Keepit Dam Road. These occured on fertile level to gentle slopes on the Peel River floodplain and prior to clearing this community would have occurred more extensively on alluvial soils in moister sites, in a mosaic with White Box-dominated or Blakely's Red Gum-dominated woodland. Surrounded by cultivated agricultural land, with the understorey replaced by introduced pasture grasses and weeds, and heavily grazed, these remnants were in poor condition.

Photograph 3-1 White Box Yellow Box Blakely's Red Gum Woodland

Photograph 3-2 Hillside of White Box Yellow Box Blakely's Red Gum Woodland dominated by White Cypress Pine

Photograph 3-3 **White Box Yellow Box Blakely's Red Gum Woodland dominated by White Cypress Pine**

3.1.2 Poplar Box Open Woodland

This community occurred in flood prone areas on level to gentle slopes at lower altitudes (generally less than 340 metres above sea level). Its main occurrence in the study area was within the travelling stock reserve on the south-eastern side of Lake Keepit. It also commonly occurred as small remnants on low lying areas on the foreshore of Lake Keepit (refer *Figure 3-1*).

The community was almost entirely dominated in the overstorey by *Eucalyptus populnea* (Poplar Box). The mid-storey was very sparse with scattered tree and shrubs such as *Geijera parviflora* (Wilga) and *Acacia pendula* (Weeping Myall). The understorey comprised native grasses including *Bothriochloa macra, Dichanthium sericeum* and *Austrostipa* spp (refer *Photograph 3-4*).

Many of the areas had dense stands of regrowth *E. populnea*, though some remnants were open with scattered trees. Most of this community was in moderate to good condition.

Photograph 3-4 Poplar Box Woodland

3.1.3 Silver-leaved Ironbark Open Woodland

This community generally occurred on hillslopes, including foreshores of Lake Keepit (refer *Figure 3-1*). It was very similar structurally and floristically to White Box Yellow Box Blakely's Red Gum Woodland and Poplar Box Open Woodland, except that the overstorey was dominated by *Eucalyptus melanophloia* (Silver-leaved Ironbark) (refer *Photograph 3-5*).

This community was less disturbed than other vegetation within the study area, had a high species diversity and contained few weeds. This community was in good condition.

Photograph 3-5 Silver-leaved ironbark Woodland

3.1.4 River Red Gum Woodland

This community occurred on deep alluvium along the banks of the Namoi and Peel Rivers (refer *Photograph 3-6*) and in proximate areas subject to periodic inundation (refer *Figure 3-1*). This community was observed to be expanding to include the margins of the high water mark of Lake Keepit. In these areas, a narrow band (approximately 10 metres wide) of young saplings of *E. camaldulensis* was observed (refer *Photograph* 3-7).

This community was dominated by *Eucalyptus camaldulensis* (River Red Gum) and *Casuarina cunninghamiana* (River She-oak). Many of the overstorey trees in these parts of the study area had been removed and the understorey was usually highly degraded by heavy grazing or cropping. Additionally, many of the old remnant River Red Gums were senescing, with no recruitment of the species occurring in these areas.

Woody weed species (e.g. *Salix* spp. and *Schinus areira*) also commonly occurred in this community, especially along the Namoi River below the main dam wall. Hence, this vegetation community was mostly in poor condition.

Photograph 3-6 River Red Gum Woodland (Peel River)

Photograph 3-7 River Red Gum Woodland (Lake Keepit foreshores)

3.1.5 Grassland

Most areas of grasslands were likely to have been created by past clearing of overstorey Eucalypt cover. Many areas were also likely to contain a mix of native and introduced species, however, even heavily cultivated areas can return to native pasture within a few years if the areas are spelled (Hunter 2002).

Native grasslands cannot be differentiated by means of aerial photographic interpretation from those comprised wholly or partially of introduced species. However, ground truthing of vegetation mapping indicated that the majority of grassland within the study area was dominated by native species such as *Austrostipa verticillata, Bothriochloa* spp., *Dichanthium sericeum, Chloris verticillata* and *Enneapogon gracilis* (*Photograph* 3-8). This community also includes typical introduced pasture and weed species but was generally dominated by native species of grass. This community is in poor condition.

Based on the altitude, topography and remnant trees or nearby vegetation the much of this community within the vicinity of the site is likely to have once supported Poplar Box Woodland. This community would not correspond to a derived grassland of White Box Yellow Box Blakely's Red Gum Woodland because it does not have an intact native ground cover with a high diversity of native species (more than 12 native perennial species, excluding grasses) or important species (Department of the Environment and Heritage 2006d).

Photograph 3-8 Grassland

3.2 Species of plant

A total of 114 species of plant was recorded within the study area during this and previous surveys (refer *Attachment B*) of which 82 (72%) are native.

Six of the species recorded within the study area are listed as noxious species in the Gunnedah Shire and/or Tamworth Regional Noxious Weed Control Areas under the *Noxious Weeds Act 1993* (refer *Table 3-1*). Other noxious and environmental weeds of concern that occur in the region include: *Hyparrhenia hirta* (Coolotai Grass), *Cenchrus* spp. (Spiny Burr Grass), *Sorghum halepense* (Johnson Grass), *Hypericum perforatum* (St John's Wort), *Eragrostis curvula* (African Lovegrass), *Cestrum parqui* (Green Cestrum) and *Phyla* spp. (Lippia).

Table 3-1 Noxious species recorded within the study area

Scientific name	**Common name**	**Noxious weed class[1]**	**Management requirements[1]**
Bryophyllum species	Mother-of-millions	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.
Cylindropuntia species	Prickly pears		
Echium spp.	Paterson's Curse		
Heliotropium amplexicaule	Blue Heliotrope		
Opuntia aurantiaca	Prickly pear		
Opuntia stricta	Prickly pear		
Xanthium species	Nagoora Burr, Bathurst Burr		
Salix species	Willows	5	The requirements in the *Noxious Weeds Act 1993* for a notifiable weed must be complied with.

1 Defined by the *Noxious Weeds Act 1993*

3.3 Fauna habitats

The vegetation in the study area composed a mosaic of isolated woodland patches interspersed with cleared grazing country, as well as riparian woodlands along the Namoi and Peel Rivers. Suitability, size and configuration of fauna habitats correlated broadly with the structure, floristics, connectivity and quality of the local and regional vegetation types as described above.

Grasslands were the most widely occurring habitat type in the study area and offered limited resources for native animals, due to the low floristic and structural diversity of the vegetation. Isolated paddock trees were scattered throughout the study area. Remnant trees in paddocks can be important in agricultural landscapes for the conservation of fauna in the region as they provide habitat to a range of fauna and also help to maintain connectivity between larger patches of vegetation thus contributing to the viability of fauna populations (Gibbons & Boak 2000).

The open woodlands (White Box, Poplar Box, Yellow Box, Silver-leaved Ironbark and Blakely's Red Gum) contained some areas with grassy understorey foraging habitats. Logs and fallen branches were present in low to moderate numbers and provided breeding, hibernation and sheltering sites for native animals. Small to medium sized tree hollows were recorded within Box trees. Remnant and regrowth open woodland areas were generally in moderate condition.

Thick stands of White Cypress Pine (*Callitris glaucophylla*) trees occurred in previously cleared woodland in areas around the existing infrastructure at the existing main dam wall and the Lake Keepit Sport and Recreation Centre. The groundcover habitats were limited to small amounts of fallen dead branches and trees, and a limited number of hollow-bearing eucalypts. The foliage of White Cypress Pine provides shelter for small birds; whereas cockatoos and galahs are known to feed on *C. glaucophylla* seeds (Thompson & Eldridge 2005). The habitats were in poor condition.

The riparian zone of the Namoi and Peel Rivers provided a variety of habitat features including mature hollow-bearing Red Gum trees (*Eucalyptus camuldulensis*), fallen dead wood and leaf litter. The availability of freshwater provided drinking resources for birds and mammals as well as breeding habitat for common frogs. The riparian habitats of the Peel River were in relatively poorer condition than the Namoi River, however, both rivers provided important habitat linkage throughout the region across the surrounding agricultural landscape.

Habitat connectivity with other remnant habitats in the landscape was intact on the south-western side of Lake Keepit although connectivity throughout the study area was generally limited to isolated patches of woodland. Details of microhabitat features are presented below in *Table 3-2* and mapping of habitat condition is shown in *Figure 3-2*.

Table 3-2 Description of fauna habitat for each vegetation type in the study area

Microhabitat component	Habitat					
	Grassland	**Grassy Box Woodland (White, Poplar and Yellow Box)**	**White Box–White Cypress Pine Woodland**	**Blakely's Red Gum Open Woodland**	**River Red Gum Woodland**	**Silver-leaved Ironbark Open Woodland**
Upper canopy	▪ Absent ▪ Some isolated paddock trees are present	▪ Sparse to moderately dense in some areas ▪ 15-20 metres tall ▪ Myrtaceous tree species provide seasonal foraging resource for nectivorous birds ▪ Mistletoes present (produces nectar, fruit and seeds)	▪ 15 metres tall ▪ Dominated by mono-specific stands of dense *Callitris* pine in some areas used for nesting by birds ▪ Some White Box trees present	▪ 10-15 metres tall ▪ Moderately dense	▪ 20-30 metres tall ▪ Sparse ▪ Flowers of red gums provide seasonal foraging resources	▪ 10-15 metres tall ▪ Moderately dense in elevated areas
Understorey vegetation (shrubs, grasses, herbs and forbs)	▪ Dominated by native and introduced species of grass present ▪ Low floristic and structural diversity ▪ Limited resources ▪ Subject to grazing activity	▪ Grasses provide seasonal foraging for granivorous birds and highly mobile mammals ▪ Good quality habitats within the travelling stock reserve east/ south of Keepit Dam	▪ Generally absent ▪ Some open areas contain native grasses	▪ Grasses provide seasonal foraging for granivorous birds and highly mobile mammals	▪ Limited ▪ Some grasses (foraging for granivorous birds) however, generally heavily grazed	▪ Moderate diversity of shrubs and grasses ▪ Provide browsing resources for macropods ▪ Foraging resources for granivorous birds
Groundcover features	▪ Generally absent	▪ Thin leaf litter layer ▪ Moderate amount of fallen dead trees/ logs and timber in crown reserve (travelling stock reserve) ▪ Other woodland patches have limited groundcover features	▪ Limited ▪ Some open areas have thin layer of leaf litter and fallen dead branches ▪ Exposed rock surface available from *Callitris* growth, however densely shaded	▪ Thin leaf litter layer ▪ Small amount of fallen dead trees and timber	▪ Generally absent ▪ Some of the upstream inundated areas have moderately thick layer of leaf litter	▪ Upstream areas on ridges above high water mark have moderate surface rock cover ▪ South of Manilla Ski Gardens, western and northern parts of Lake Keepit

Microhabitat component	Habitat					
	Grassland	**Grassy Box Woodland (White, Poplar and Yellow Box)**	**White Box–White Cypress Pine Woodland**	**Blakely's Red Gum Open Woodland**	**River Red Gum Woodland**	**Silver-leaved Ironbark Open Woodland**
Tree hollows and stags	▪ Some isolated paddock trees (White Box and Poplar Box) contain medium-sized tree hollows	▪ Small to medium-sized hollows ▪ Likely to be used by microbats for roosting, and by birds and arboreal mammals for nesting ▪ Inundated areas of Poplar Box trees have formed hollows within dead stags	▪ Small-sized tree hollows in some random White Box trees	▪ Absent	▪ Medium to large hollows present used by parrots, possums and microbats ▪ Stags present from inundated dead trees and are used by waterbirds for breeding	▪ Generally absent, however some small hollows present
Drainage lines and waterbodies	▪ Absent	▪ Namoi and Peel Rivers provides permanent freshwater, providing breeding habitat for common frogs	▪ Absent	▪ Absent	▪ Namoi and Peel Rivers provides permanent freshwater, providing breeding habitat for common frogs	▪ Absent
Overall condition	▪ Poor	▪ Moderate	▪ Poor - moderate	▪ Riparian habitats of the Peel River were in relatively poor condition. The Namoi River was in moderate condition	▪ Moderate - high	▪ Moderate

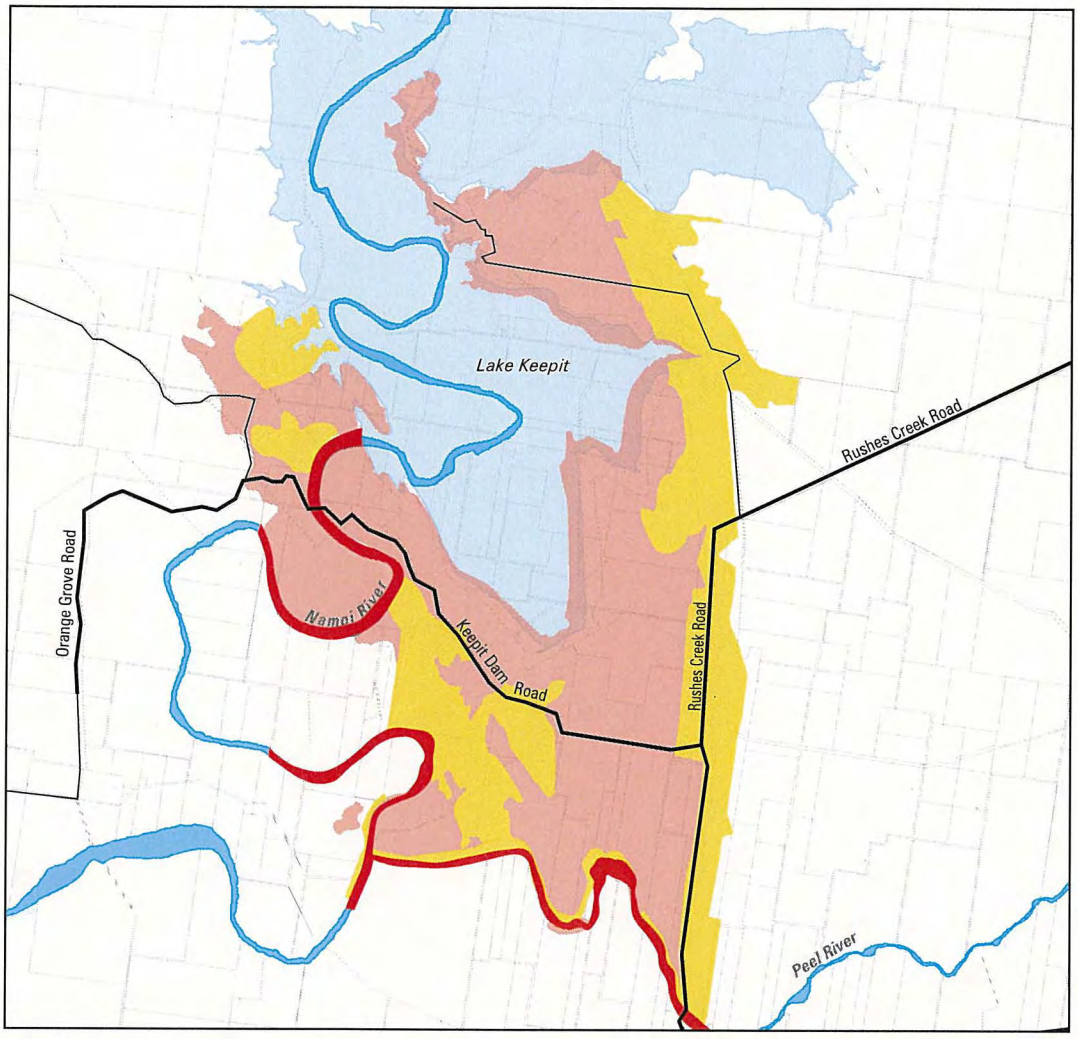


Figure 3-2 **General condition of fauna habitats throughout the study site**

3.4 Species of animal

A total of 124 species of animal were recorded in the study area during field surveys comprising 110 bird, 11 mammal, two reptile and one amphibian species. Four of the species of mammal recorded were introduced species. The full list of animals recorded during the current survey is shown in *Attachment C.*

Many of the native fauna species recorded or considered likely to occur in the study area are those tolerant of variegated landscapes. The grasslands are used as a foraging area by Eastern Grey Kangaroos and granivorous and open country species of bird. Microchiropteran bats, generalist species of bird and possums use the hollows of mature box trees for nesting and/ or roosting.

Two Threatened species listed as Vulnerable under the *Threatened Species Conservation Act 1995* were recorded during the field surveys: Speckled Warbler (*Pyrrholaemus sagittatus*) and Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*).

3.5 Species, populations and communities of conservation concern

3.5.1 Threatened ecological communities

Endangered and Vulnerable ecological communities are listed under Schedule 1 of the *Threatened Species Conservation Act 1995*, while Threatened ecological communities are listed under the *Environment Protection and Biodiversity Conservation Act 1999* as Critically Endangered, Endangered or Vulnerable. Five Threatened ecological communities have been identified as occurring in the locality:

- White Box Yellow Box Blakely's Red Gum Woodland
- semi-evergreen Vine thicket in the Brigalow South and Nandewar bioregions
- native vegetation on cracking clay soils of the Liverpool Plains
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions
- Inland Grey Box Woodland in the Riverina , New South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (Preliminary Listing under the *Threatened Species Conservation Act 1995*).

Of these, only White Box Yellow Box Blakely's Red Gum Woodland was recorded within the study area. This community is listed as Endangered under Part 3 of Schedule 1 of the *Threatened Species Conservation Act 1995* (NSW Scientific Committee 2002) and Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment and Heritage 2006d; Threatened Species Scientific Committee 2006). The final determination of the NSW Scientific Committee makes reference to the occurrence of this community in Lake Keepit State Park.

The White Box Yellow Box Blakely's Red Gum Woodland within the study area (described in *Section 3.1*) matches criteria in the identification guidelines for this threatened ecological community prepared by the NSW National Parks and Wildlife Service (2002b) that identify it as constituting this Endangered Ecological Community, namely:

- it is within the area defined in the determination: the site is within the Nandewar bioregion
- there are native species in the understorey and there is potential for assisted natural regeneration of the overstorey or understorey
- characteristic trees are, or are likely to have been, White Box, Yellow Box or Blakely's Red Gum
- the site is mostly grassy, although shrubs, particularly pioneer species, may be locally common (NSW National Parks and Wildlife Service 2002b).

The community also matches criteria provided by the Department of the Environment and Heritage(Department of the Environment and Heritage 2006d), namely:

- at least one of the most common overstorey species is, or was, White Box, Yellow Box, Blakely's Red Gum, Western Grey Gum or Coastal Grey Box
- the patch has a predominantly native understorey
- the patch is either:
  - 0.1 hectares or greater in size and there are 12 or more native understorey species present (excluding grasses and at least one important species, or
  - greater than 2 hectares and contains on average more than 20 mature trees per hectare or there is natural regeneration of the dominant overstorey eucalypts.

The listing for this community includes derived grasslands, however, the grasslands within the site are not considered to form part of this community because they were either:

- not previously dominated by one of the characteristic species. Much of the grasslands are thought to have once supported Poplar Box Woodland (based on altitude, topography and remnant trees or nearby vegetation).
- less than 0.1 hectares
- did not contain more than 12 native species (excluding grasses) and were:
  - less than 2 hectares
  - greater than 2 hectares but did not have an average of 20 or more mature trees per hectare or native regeneration of eucalypts (Department of the Environment and Heritage 2006d).

3.5.2 Endangered populations

Endangered populations are listed under Schedule 1, Part 2 of the *Threatened Species Conservation Act 1995*. Two Endangered populations listed under the *Threatened Species Conservation Act 1995* occur within the region:

- Tusked Frog
- Australian Brush-turkey.

Of these, only the Australian Brush-turkey is known to occur within the Namoi Catchment Management Area (which covers the study area). No records or potential habitat for these species exist in the study area. These populations are unlikely to be affected by the construction and operation of the proposal.

3.5.3 Threatened species of plant

Thirteen Threatened species of plant have been recorded within the project locality (refer *Attachment D*). Two of these have been recorded within the study area: *Hakea pulvinifera* and *Bothriochloa biloba* (refer *Figure 3-1*). A further five have potential habitat within the study area: *Diuris tricolor, Digitaria porrecta, Goodenia macbarronii, Swainsona murrayana and Dichanthium setosum*.

The only known population of *Hakea pulvinifera* grows on a steep, rocky slope of Keepit Conglomerate on the western side of the Namoi River, 2 kilometres directly south of the main dam wall embankment (Hunter 2002). The population grows within *Callitris glaucophylla* open woodland with a groundcover of *Cymbopogon obtectus* and *Themeda australis.* There are less than 150 individuals with two age classes evident. The older class is senescent and is in decline. The plants are between 310 and 350 metres altitude above sea level (NSW National Parks and Wildlife Service 2000). If the main dam wall were to fail during a very large to extreme flood event i.e. the 'do nothing' scenario approximately half of this population is likely be destroyed by high velocity water flows.

A single individual of *Bothriochloa biloba* which is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* was recorded previously downstream of the subsidiary dam wall (Hunter 2002). This species is common in roadside vegetation in the region (pers comm. P. Sparkes).

3.5.4 Threatened species of animal

Thirty-four Threatened faunal species have been recorded previously or have the potential to occur in the study area, comprising 17 bird, 13 mammal, two reptile and two amphibian species (refer *Attachment D*). Of the total 34 Threatened species, 28 are listed under the *Threatened Species Conservation Act 1995*, and 12 are also listed under the *Environment Protection and Biodiversity Conservation Act 1999* (refer *Attachment D*).

Two Threatened species listed as Vulnerable under the *Threatened Species Conservation Act 1995* were recorded during the field surveys:

- Speckled Warbler (*Pyrrholaemus sagittatus*)
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*).

The Speckled Warbler was recorded on the ridges of White Box Open Eucalypt Woodland (dominated by *Callitris glaucophylla*) located within 1 kilometre of the caravan park. The Yellow-bellied Sheathtail Bat was recorded foraging in open country surrounding box woodland on the eastern side of Lake Keepit.

Threatened parrots, honeyeaters, ground-dwelling insectivorous and granivorous birds and microbats may also use habitats in the study area. The likelihood of their occurrence and use of habitats are described in *Attachment D.*

3.5.5 Migratory species

Migratory species are protected under international agreements to which Australia is a signatory including the *Japan Australia Migratory Bird Agreement* (JAMBA), the *China Australia Migratory Bird Agreement* (CAMBA) and the *Bonn Convention on the Conservation of Migratory Species of Wild Animals*. Migratory species are considered matters of national environmental significance and protected under the *Environment Protection and Biodiversity Conservation Act 1999*.

Twenty-two migratory bird species listed under these agreements have been recorded in the study area or have the potential to occur (refer *Attachments C* and *D*).

Under the *Environment Protection and Biodiversity Conservation Act 1999* an action is likely to have a significant impact on a migratory species if it modifies or disrupts an important area of habitat for the species or a significant proportion of the population (Department of the Environment and Heritage 2006c).

The study area is not considered important habitat for any migratory species in that it does not contain habitat:

- utilised by a migratory species occasionally or periodically in a region that supports an ecologically significant proportion of the population of the species
- utilised by a migratory species that is of critical importance to the species at particular life-cycle stages
- utilised by a migratory species which is at the limit of the species' range
- in an area where the species is declining (Department of the Environment and Heritage 2005).

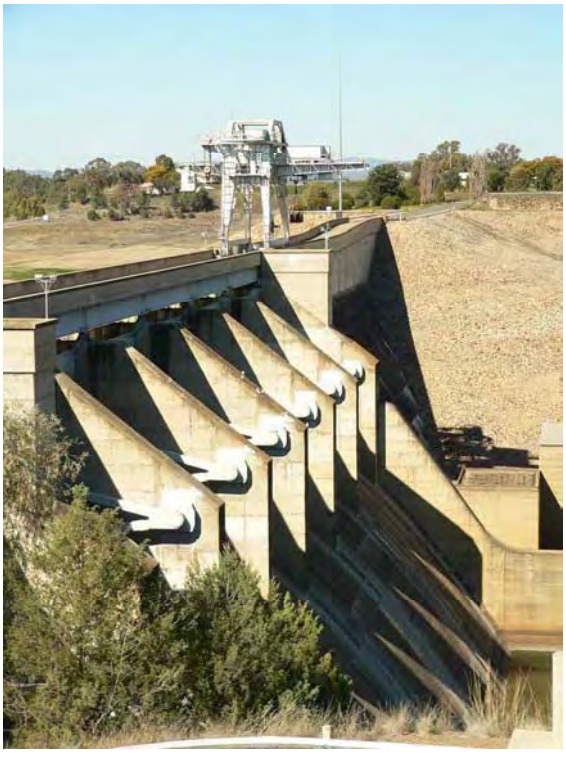
Therefore, the potential for impacts of the proposal on migratory species are not considered further.

4. Impacts

This Chapter describes the construction and operational impacts of the three short-listed dam safety upgrade options.

A description of the vegetation and habitats within each of the construction sites is provided in Table 4-1.

Table 4-1 Description of construction sites

Construction site	Description	Photo
Right hand abutment spillway, stockpile and peninsula reshaping (all options)	▪ White Box Yellow Box Blakely's Red Gum Woodland dominated by *Callitris glaucophylla* (20 % cover), *E. albens* (10 % cover) ▪ Low weed invasion ▪ Good condition	
Main Dam Wall (all options)	▪ Previously cleared and largely bare ▪ Dominated by introduced grasses and herbs ▪ Poor condition	

Construction site	Description	Photo
Stockpile areas (south of dam wall) (all options)	▪ Previously cleared, some stunted *Brachychiton populneus* and *Callitris glaucophylla* present ▪ Dominated by introduced grasses and herbs ▪ Some plantings of introduced species including Jacarandas ▪ Poor condition	
Caravan Park Saddle Dam (all options)	▪ Previously cleared ▪ Dominated by a low canopy of *Callitris glaucophylla* and planted, non-endemic eucalypts and *Schinus areira* ▪ Understorey grassy, including *Austrostipa verticillata* and *Sclerolaena birchii* as well as introduced herbs and grasses. ▪ Moderate condition	
Boat ramp saddle dam (option B1) or spillway (options D2 and D3)	▪ Previously cleared ▪ Includes powerline easements and boat ramp access road ▪ Includes cleared grassland as well as White Box Yellow Box Blakely's Red Gum Woodland ▪ Cleared grassland is mown. Woodland includes native ground cover species such as *Bothriochloa macra* and *Austrodanthonia* spp. ▪ Moderate level of weed invasion and scattered introduced trees and shrubs such as Grevillea robusta also occur	

Construction site	Description	Photo
Sailing club saddle dam (option B1) or spillway (options D2 and D3)	▪ Previously cleared to the south ▪ White Box Yellow Box Blakely's Red Gum Woodland to the north ▪ Dominated by a low canopy of *Callitris glaucophylla. Grevillea robusta* also present. ▪ Understorey dominated by grasses and introduced herbs ▪ Poor condition	
Subsidiary dam wall (options D2 and D3) /spillway (option B1)	▪ Previously cleared ▪ Dominated by introduced grasses and herbs ▪ Poor condition	

4.1 Construction impacts

Bulk earthworks are proposed for construction of the right-hand abutment spillway to widen the flow entry to the spillway, a new spillway wall and apron, and a new gravel road to the peninsula adjoining the flow entry.

Raising the main dam wall by 3.4, 4.6 or 5.5 metres (for Options B1, D2 and D3 respectively) would involve raising of the bridge deck, gate lifting gear, gantry crane, concrete wall and earthen embankment of the main dam wall. Raising the subsidiary dam wall would be achieved by building up the wall with compacted earth fill, and adding additional rock armour upstream.

Construction of an earthen saddle dam at the rear of the caravan park to match the height of the raised main dam wall is proposed for all three short-listed options. For Option B1, two other saddle dams are also proposed at the sailing club and boat ramp. Saddle dam construction would essentially comprise bulk earthworks using bulldozers, scrapers, off-road haul trucks and compaction equipment. Fill from spillway crushed excavation and clay from on-site borrow pits is expected to be adequate. Rock armour would also be added to the upstream faces likely sourced from bulk excavation works on-site and externally.

For Option B1, construction of a saddle dam at the rear of the caravan park would necessitate relocation of one row of caravans (up to eight caravans), an amenities block and associated services of The Gums caravan park. Taller embankments associated with Options D2 and D3 would necessitate the relocation of up to two rows, or 15 caravans,

as well as the amenities block and associated services. The caravans would be relocated to a location agreed with the Lake Keepit State Park Trust in consultation with caravan owners, possibly to the south-west of The Gums caravan park.

For Options D2 and D3, additional spillways would be constructed at the sailing club and boat ramp. Drilling and blasting and bulk excavation of rock are proposed to create the additional spillways. The existing boat ramp would need to be relocated as part of the construction works as would the sailing club, subject to finalising the location of the spillway relative to the proposed sailing club building. The existing access road to the sailing club and boat ramp would also be relocated.

The same generic construction impacts would apply to all three short-listed dam safety upgrade options and would include:

- clearing of vegetation and habitat disturbance
- removal of dead wood and trees
- fragmentation and edge effects
- noise and other human disturbance
- soil erosion and compaction
- fauna injury, and
- increased weed invasion.

Clearing of vegetation and habitat disturbance

Clearing of native vegetation is listed as a Key Threatening Process under both the Threatened Species Conservation Act 1995 and the Environment Protection and Biodiversity Conservation Act 1999. Under the Threatened Species Conservation Act 1995 native vegetation is made up of plant communities, comprising primarily indigenous species, the composition and structure of which reflects the interactions between plant species, between plants and fauna and with the environment. Native vegetation includes canopy trees (where present), understorey, ground cover and below ground biomass (roots, bulbs and the seed bank). Clearing is defined as the destruction of a sufficient proportion of one or more strata (layers) within a stand or stands of native vegetation so as to result in the loss, or long term modification, of the structure, composition and ecological function of a stand or stands (NSW Scientific Committee 2001a).

Clearing of native vegetation has:

- caused widespread fragmentation of ecological communities
- reduced the viability of ecological communities by disrupting ecological functions
- resulted in the destruction of habitat and loss of biological diversity
- led to soil and bank erosion, increased salinity and loss of productive land.

Approximately 41.0 hectares, 49.8 hectares and 49.3 hectares of vegetation are proposed for clearing during construction for Options B1, D2 and D3 respectively (*Table 6*). This includes approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of Box Gum Woodland for Options B1, D2 and D3 respectively (*Table 6*).

Table 4-2 Extent of clearing of vegetation

Vegetation type	Options Extent of clearing (hectares)			Total in mapped area[1]
	B1	D2	D3	
Grassland (modified native or introduced)	23.3	12.8	14.0	1,524
Grassland / Cultivated agricultural land or otherwise highly modified	4.1	19	17.7	83
Poplar Box Open Woodland	0	0	0	273
River Red Gum Open Woodland	0	0	0	94
White Box Woodland, Yellow Box Blakely's red Gum Woodland (EEC)	13.6	18.0	17.6	902
TOTAL	**41.0**	**49.8**	**49.3**	**2,879**

[1]Total mapped area, including paved areas, is 2,955 hectares

Habitats that will be removed include foraging and nesting resources including tree hollows. The removal of Hollow- bearing trees has as been preliminarily listed as a Key Threatening process under the *Threatened Species Conservation Act 1995*.

Removal of dead wood and trees

The construction works include the removal of dead wood and dead trees which is also listed as a Key Threatening Process under the *Threatened Species Conservation Act 1995*. Logs and fallen branches are present in low to moderate numbers within open Box Woodland and riparian woodland, providing breeding, hibernation and sheltering sites for native animals.

Fragmentation and edge effects

Habitat fragmentation through the clearing of vegetation would increase the isolation of remnant vegetation and create barriers to the movements of small and sedentary fauna such as ground-dwelling mammals, reptiles and amphibians.

Edge effects are zones of changed environmental conditions (i.e. altered light levels, wind speed, temperature) occurring along the edges of habitat fragments. These new environmental conditions along the edges can promote the growth of different vegetation types (including weeds) and allow invasion by pest animals specialising in edge habitats (e.g. Noisy Miners). Edge zones can be subject to higher levels of predation by introduced mammalian predators and native avian predators. Tracks into areas of relatively intact native vegetation can provide access points for predators such as foxes and cats.

Clearance of vegetation would increase edge effects to adjacent areas of woodland, however, this is unlikely to significantly impact the condition of these remnants. The proposed clearing would not significantly alter environmental conditions of adjacent habitats or result in significant fragmentation or isolation of habitats. It is unlikely that the introduction of weeds and introduced predators would significantly increase as a result of the proposed clearing.

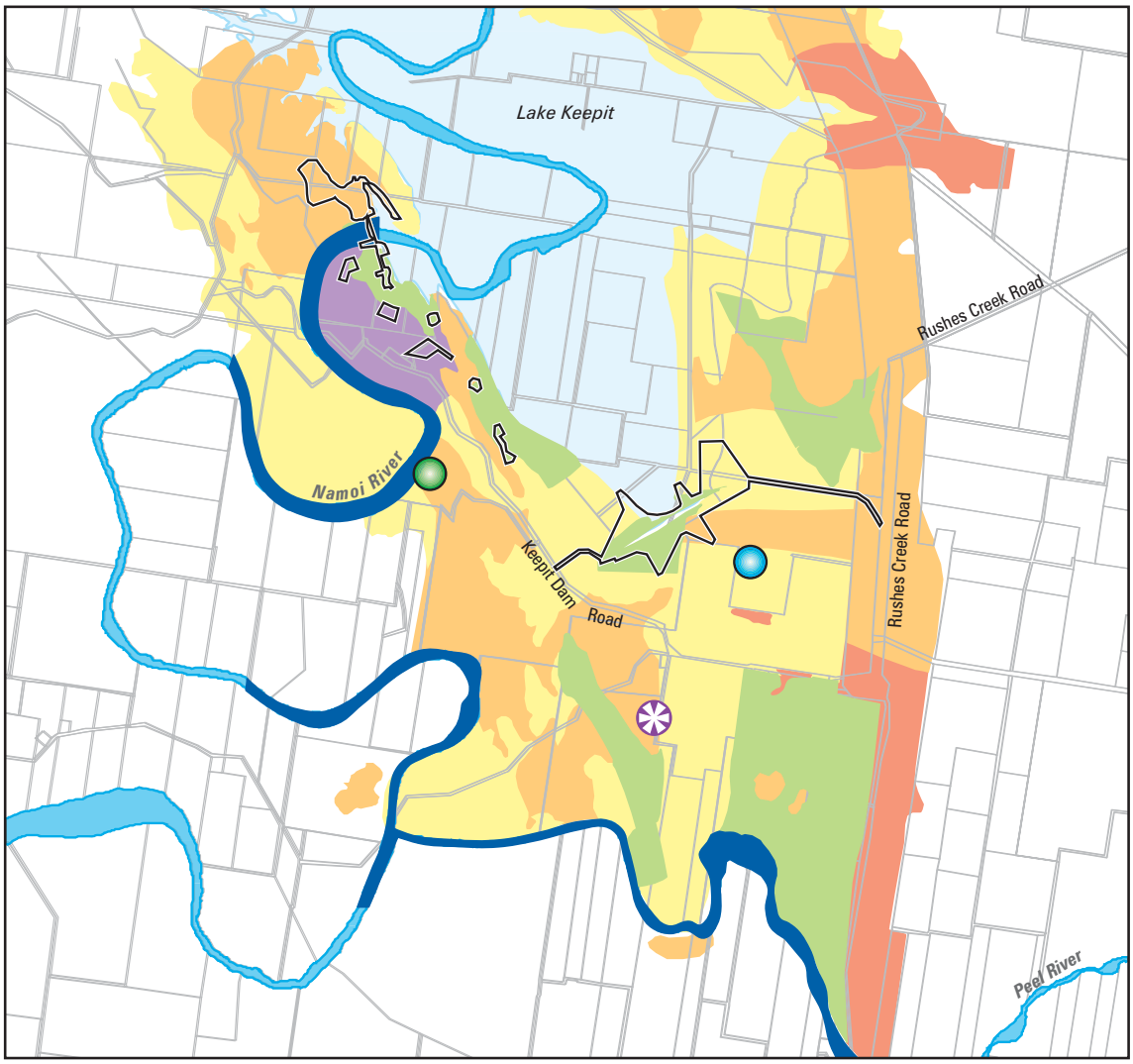


Figure 4-1a **Vegetation communities and threatened species of plants within the vicinity of the affected area for Option B1**

Vegetation communities

- Cultivated agricultural land or otherwise highly modified
- Grassland (modified native or introduced)
- Grassland/cultivated agricultural land or otherwise highly modified
- Poplar Box Open Woodland
- River Red Gum Open Woodland
- White Box Yellow Box Blakely's Red Gum Woodland (EEC)

- Dam full supply level
- All areas affected by construction (e.g. construction work areas, stockpile areas, construction vehicle accesses, relocated facilities and roads)

Threatened plants (Hunter 2002)

- *Bothriochloa biloba*
- *Hakea pulvinifera*

Threatened animal (this survey)

- Speckled Warbler

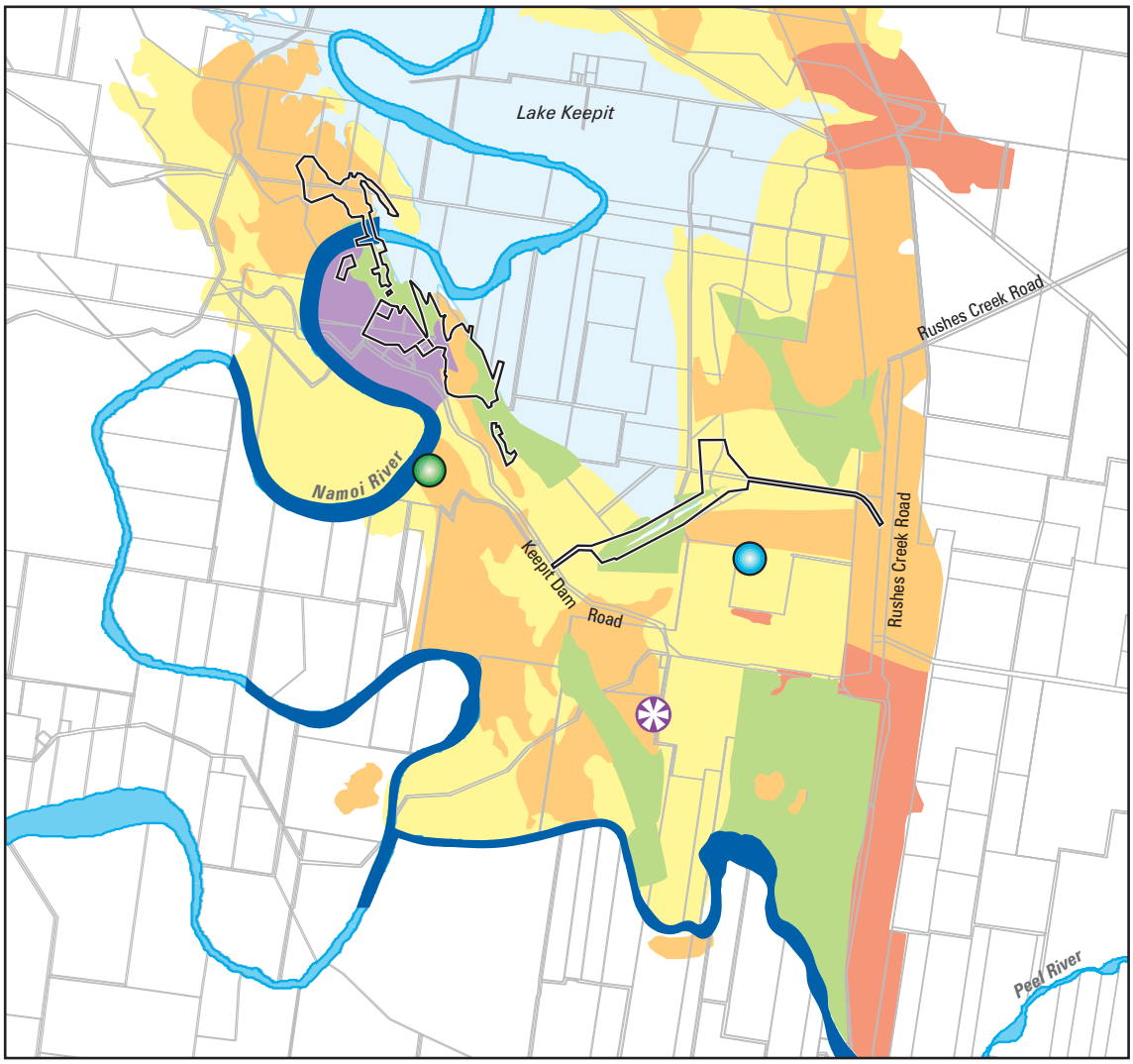


Figure 4-1b **Vegetation communities and threatened species of plants within the vicinity of the affected area for Option D2**

Vegetation communities

- Cultivated agricultural land or otherwise highly modified
- Grassland (modified native or introduced)
- Grassland/cultivated agricultural land or otherwise highly modified
- Poplar Box Open Woodland
- River Red Gum Open Woodland
- White Box Yellow Box Blakely's Red Gum Woodland (EEC)

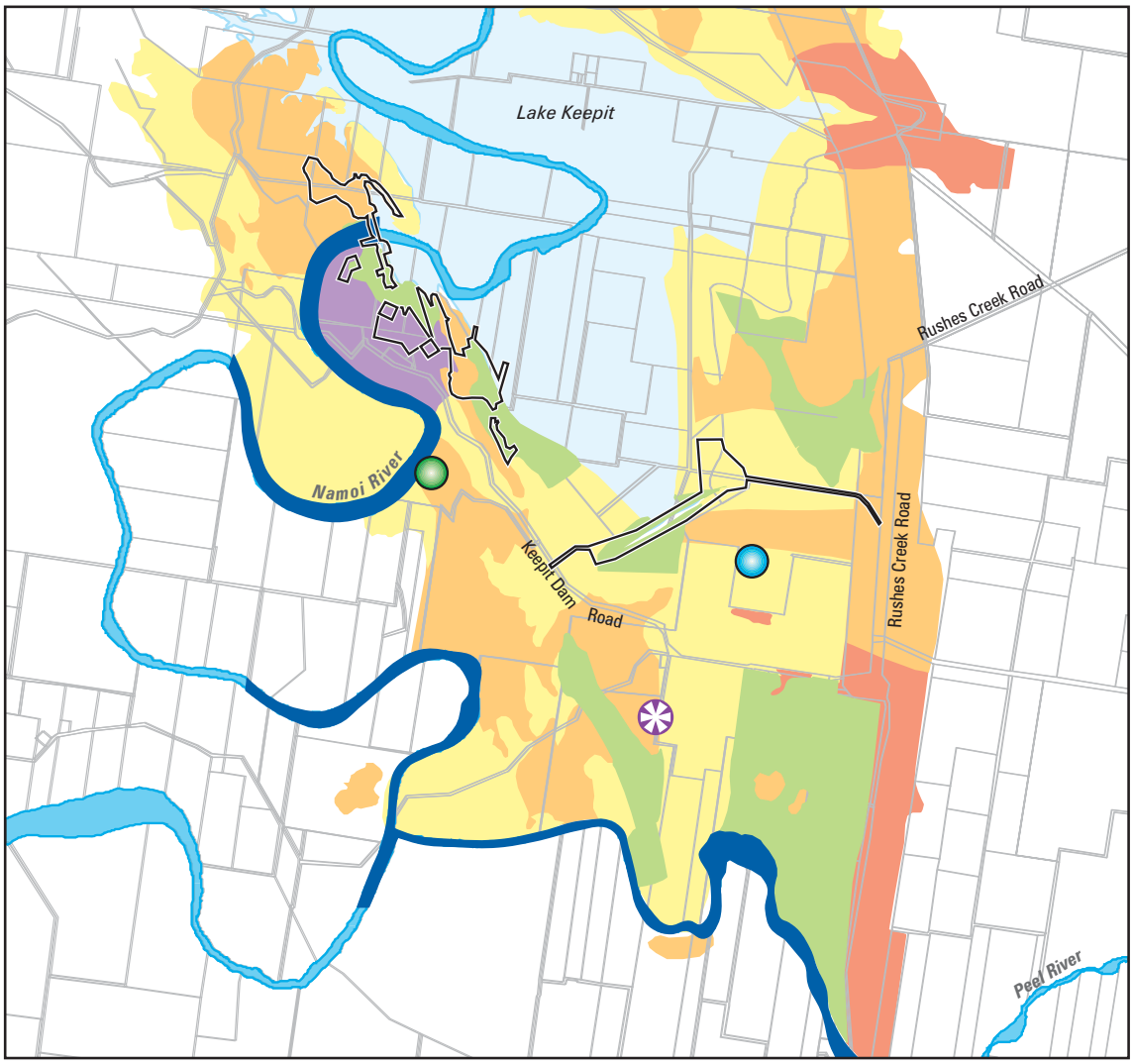
- Dam full supply level
- All areas affected by construction (e.g. construction work areas, stockpile areas, construction vehicle accesses, relocated facilities and roads)

Threatened plants (Hunter 2002)

- *Bothriochloa biloba*
- *Hakea pulvinifera*

Threatened animal (this survey)

- Speckled Warbler



N

0 2

kilometres

Figure 4-1c **Vegetation communities and threatened species of plants within the vicinity of the affected area for Option D3**

Vegetation communities

- Cultivated agricultural land or otherwise highly modified
- Grassland (modified native or introduced)
- Grassland/cultivated agricultural land or otherwise highly modified
- Poplar Box Open Woodland
- River Red Gum Open Woodland
- White Box Yellow Box Blakely's Red Gum Woodland (EEC)

- Dam full supply level
- All areas affected by construction (e.g. construction work areas, stockpile areas, construction vehicle accesses, relocated facilities and roads)

Threatened plants (Hunter 2002)

- *Bothriochloa biloba*
- *Hakea pulvinifera*

Threatened animal (this survey)

- Speckled Warbler

Noise and other human disturbance

Construction activities are likely to increase noise levels within the study site above the current background levels that are typical of remote rural environments. This may cause temporary disturbance for animals in the immediate local area during construction activities. However, construction noise is unlikely to have a significant impact on the long term survival of the local population of animals.

Soil erosion and compaction

The principal impacts on soils associated with construction activities are related to erosion and compaction. Erosion typically occurs where vegetation has been removed and construction activities have led to a concentration of surface water flows. This is likely to be most pronounced on steeper slopes such as the right-hand abutment.

Fauna injury

Fauna injury or death can occur as a result of construction activities when vegetation (and habitat) is cleared and as a result of collision with vehicles along access tracks.

While some mobile species, such as birds, may be able to move away from the path of clearing, other species that are less mobile or those that are nocturnal and restricted to tree hollows may find it difficult to move rapidly over large distances.

Increased weed invasion

Weed invasion occurs as a result of weed seeds and propagules being spread into a new area. Vectors for weed spread include motor vehicles, equipment and clothing. Changes in the environment including increased edge effects, altered light, water and nutrient levels can promote the growth of weeds and provide conditions in which weed species are able to out compete native species. Increased traffic in the area as a result of opening the area to mining is likely to increase weed invasion while vegetation clearing is likely to allow weeds to grow and spread. The level of weed invasion within the area will depend on the extent of traffic, vegetation clearing and other environmental changes within the area.

4.1.1 Comparison of options

In general, all three options have similar impacts during construction as the majority of the works occur within the same areas. The key distinction between the options is the area of vegetation and quality of habitat proposed for clearing and in particular the area of White Box Yellow Box Blakely's Red Gum Woodland proposed for clearing. A slightly smaller area of White Box Yellow Box Blakely's Red Gum Woodland is proposed for clearing for Option B1 than Options D2 and D3.

4.2 Operation impacts

Operation impacts of the three short-listed dam safety options to terrestrial biodiversity would only occur during very large to extreme floods and are therefore considered unlikely. These impacts were assessed by an expert panel that included an ecologist and are described in *Chapter 6* of the Environmental Assessment.

The significance assessments for Threatened species discussed in *Chapter 6* and contained in *Attachment G* include an assessment of operational impacts to Threatened species.

5. Mitigation and management measures

5.1 Mitigation of construction impacts

A general principle of environmental management is to, in order of preference:

- avoid environmental impacts
- minimise impacts
- mitigate the impacts
- as a last resort once the above options have been investigated, compensate for the residual impacts through biodiversity offsets.

The following measures would be implemented to mitigate the construction impacts of the proposal under the categories identified above:

Avoid environmental impacts

- Removal of trees, particularly those with hollows, would be avoided wherever possible. This would be achieved during the design phase where if possible, the footprint would be minimised and work areas would be placed in areas cleared of vegetation. The maximum work area would be clearly marked to prevent clearing beyond this area. Prior to any clearing, a comprehensive catalogue will be produced of the location and nature of large habitat trees including hollow-bearing trees.

Minimise environmental impacts

- The extent of clearing and disturbance to the native vegetation would be kept to a minimum so that impact on flora and fauna is restricted.
- Access for workers, their equipment and vehicles would be restricted to construction areas and designated access tracks. No access would be allowed within bushland surrounding the site.
- Colour tape or ‘parawebbing’ would be used to delineate the maximum work area permitted. This would be implemented prior to any work commencing on site. If any tape is disturbed then it would immediately be replaced along the appropriate alignment.
- Clearing and soil disturbance would be minimised, particularly in the vicinity of Threatened species.
- Soil and rock used in construction would be clean of weed seeds and propagules.
- Pre-clearing surveys would be undertaken for threatened species during the appropriate survey period. The results of the survey would be used to refine the mitigation measures. Surveys would include:

- Threatened species of plant with potential habitat *(Diuris tricolor, Bothriochloa biloba, Dichanthium setosum, Goodenia macbarronii, Swainsona murrayana*) during their flowering season (spring to early summer). If located within the site, impacts to individuals would be avoided or threatened species relocated to suitable habitat nearby where possible.
- Microbats - including harp trapping during warmer months
- Koalas
- Hollow-bearing trees
- Nests of Threatened species of bird.

Mitigate environmental impacts

- Soil disturbance would be minimised and sediment control devices would be installed prior to clearing vegetation to reduce impacts on surrounding vegetation or creeks.
- Topsoil and, as appropriate, cleared native vegetation would be stockpiled for use on the spoil rehabilitation areas. Care would be taken not to transfer top soil between areas.
- Vehicles and other equipment (including boots) would be thoroughly cleaned of soil, seeds and plant material before entering or leaving site. This will help to prevent the further spread of weed species or pathogens within the site or into the surrounding bushland.
- A clearing management plan would be prepared and implemented for areas containing native woodlands. The management plan would include tree clearing protocols such as:
  - identifying hollow bearing trees and clearing surrounding vegetation first. Allowing hollow bearing trees to stand for at least two days longer than surrounding vegetation to allow any hollow dependent species to move out and minimises injuries and the need for relocation
  - shaking the tree using a bulldozer
  - slowly pushing the tree to the ground so that it largely remains intact
  - leaving the tree in place once felled for at least one day/night before removing to allow animals to relocate to nearby vegetation
  - all contractors having the contact numbers of wildlife rescue groups should animals be injured during clearing
  - where possible, undertaking vegetation clearing during September/October or in March/May to avoid summer breeding seasons and the winter hibernation for hollow dependent species.
- Tree hollows from felled trees would be salvaged and cut into suitable lengths and erected in the vicinity on retained trees.
- Trenches would be covered when work is finished for the day to prevent animals being accidentally trapped.

- Any dead logs within construction areas would be moved to an adjacent area to minimise habitat loss.
- Construction equipment and materials would not be parked, stockpiled or stored under trees so as to avoid soil compaction within the root zone.
- Timber debris from clearing would be retained for use in revegetation areas to provide habitat and soil stabilisation.
- Revegetation would be undertaken following construction by replanting with suitable indigenous species of plant and locally endemic species of tree.

Biodiversity offsets

Where measures to avoid and mitigate are not possible, then biodiversity offset strategies need to be considered. These may include offsite or local area proposals that contribute to the long term conservation of the Threatened species (Department of Environment and Conservation 2005). Biodiversity offsets strategies investigated for the Keepit Dam Upgrade are discussed in *Section 5.1.3* of the Environmental Assessment.

5.2 Management of construction impacts

A Flora and Fauna Management Sub Plan would be prepared as part of the Construction Environmental Management Plan for the proposal. The Sub Plan would be prepared in consultation with the Department of Environment and Conservation and relevant Councils. The Sub Plan would include:

- plans showing terrestrial vegetation communities; important flora and fauna habitat areas; locations where Threatened species, populations or ecological communities were recorded; and areas to be cleared. The plans would also identify vegetation adjoining construction work sites where this contains important habitat areas and/or Threatened species, populations or ecological communities
- methods to manage impacts on flora and fauna species and their habitat which may be directly or indirectly affected by construction works, including the mitigation measures described above
- rehabilitation details including:
  - identification of locally native species to be used in rehabilitation and landscaping works, including flora species suitable as a food resource for Threatened fauna species
  - the source of all seed or tube stock to be used in rehabilitation and landscaping works including the identification of seed sources in the vicinity of the proposal. Seed of locally native species would be collected before construction commences to provide seed stock for revegetation
  - an aim of increasing the local cover of native vegetation suitable for woodland species of bird
  - methods to re-use topsoil (and where relevant subsoils) and cleared vegetation

- measures for the management and maintenance of all preserved, planted and rehabilitated vegetation.

- a Weed Management Strategy including:
  - identification of weeds within construction work sites and adjoining areas
  - weed eradication methods and protocols for the use of herbicides
  - methods to treat and re-use weed infested topsoil
  - strategies to control the spread of weeds during construction
  - specific measures to prevent spread of weeds, particularly Coolatai Grass, This should include a site assessment prior to commencement of construction. Identified areas should be treated to eliminate noxious and environmental weeds or vehicle access to these areas should be prevented, soil would not be sourced from these areas.
- a program for reporting on the effectiveness of flora and fauna management measures against the identified performance criteria. Management methods would be reviewed where found to be ineffective.

6. Significance of impacts to threatened biodiversity

Projects assessed under Part 3A of the *Environmental Planning and Assessment Act 1979* do not require assessments of significance under Section 5A of the Act. Instead, the assessment is based against heads of consideration detailed in the draft *Guidelines for Threatened Species Assessment* (Department of Environment and Conservation 2005)(refer *Attachment F*).

The heads of consideration state that a development application needs to contain a justification of the preferred option based on:

- whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values
- whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community
- whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction
- whether or not the proposal will adversely affect critical habitat (Department of Environment and Conservation 2005).

The draft Guidelines also include factors for consideration in identifying adverse impacts to threatened species, populations or ecological communities, or their habitats:

- How is the proposal likely to affect the lifecycle of a Threatened species and/or population?
- How is the proposal likely to affect the habitat of a Threatened species, population or ecological community?
- Does the proposal affect any threatened species or populations that are at the limit of its known distribution?
- How is the proposal likely to affect current disturbance regimes?
- How is the proposal likely to affect habitat connectivity?
- How is the proposal likely to affect critical habitat?

These factors are described in more detail in *Attachment F*. Threatened biodiversity listed under the *Environment Protection and Biodiversity Conservation Act 1999* were assessed following the Principal Significant Impact Guidelines (Department of the Environment and Heritage 2005). The potential impacts of the proposal on Threatened species, populations or ecological communities listed under *Threatened Species Conservation Act 1995* and the conclusions of *Environment Protection and Biodiversity Conservation Act 1999* significance assessments are addressed within the following sub-headings. These assessments take into consideration the mitigation measures proposed in *Section 5*. A referral under the *Environment Protection and Biodiversity Conservation Act 1999* has been prepared for this project and submitted to the Commonwealth Department of the Environment and Heritage.

6.1 Endangered communities

One Endangered Ecological Community (White Box Yellow Box Blakley's Red Gum Woodland) listed under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999* occurs within the study area. Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of this community is proposed for construction of Options B1, D2 and D3 respectively.

An impact assessment under the *Environment Protection and Biodiversity Conservation Act 1999* was completed for this community (refer *Attachment G*) following the *Significant Impact Guidelines* (Department of the Environment and Heritage 2006c). This assessment concluded the proposal is likely to have a significant on this community.

Following the draft *Guidelines for Threatened Species Assessment* (Department of Environment and Conservation 2005) as required for major project assessments under Part 3A of the *Environmental Planning and Assessment Act 1979,* the proposal is likely to have a significant impact on this Endangered Ecological Community because the proposal would:

- include removal (for construction) of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland for Options B1, D2 and D3 respectively and all areas should be considered to be potentially critical for the survival of the community (Department of Environment and Heritage 2004)
- affect habitat connectivity- although the majority of the proposed construction work areas are adjacent to existing clearings and infrastructure, clearing for construction would result in fragmentation of Woodland in the right-hand abutment area.

6.2 Species of plant

Two Threatened species of plant have been recorded within the study area (*Hakea pulvinifera* and *Bothriochloa biloba).* A further five have potential habitat within the study area: *Diuris tricolor, Goodenia macbarronii, Swainsona murrayana, Dichanthium setosum* and *Digitaria porrecta.*

Impact assessments for Threatened plants listed under the *Environment Protection and Biodiversity Conservation Act 1999* that occur or have potential habitat in the study area have been completed (refer *Attachment G*). The impacts to these species were also considered following the draft *Guidelines for Threatened Species Assessment* (Department of Environment and Conservation 2005). These assessments concluded that the proposal was unlikely to have a significant impact on these threatened species of plant because the habitat within the construction footprint is disturbed and provides only marginal habitat and only a small amount of habitat would be cleared for construction.

6.3 Species of animal

Significance assessments were completed for a range of Threatened species of animal considered likely to occur in the area including:

- Threatened woodland birds assessed together as a group (Brown Treecreeper, Painted Honeyeater, Hooded Robin, Black-chinned Honeyeater, Grey-crowned Babbler, Speckled Warbler and Diamond Firetail).
- Regent Honeyeater
- Swift Parrot
- Turquoise Parrot
- Microchiropteran bats considered as a group (Little Pied Bat, Eastern False Pipistrelle, Eastern Long-eared Bat, Yellow-bellied Sheathtail Bat)
- Koala.

These assessments concluded that although approximately 18 hectares of woodland habitat would be removed as part of the proposal, this represents a small percentage (1.9 %) of habitat available in the immediate local area. Further, the habitats to be removed are generally in poor to moderate condition and their removal will not fragment or isolate populations. As such it is unlikely that the proposal; would have a significant impact on any threatened species of animal if mitigation measures proposed are followed.

7. Conclusion

7.1 Justification of the proposal

The draft *Guidelines for Threatened Species Assessment* (Department of Environment and Conservation 2005) require that development applications contain a justification of the proposal based on key thresholds including:

- whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts **will maintain or improve biodiversity values**
- whether or not the proposal is likely to **reduce the long-term viability of a local population of the species, population or ecological community**
- whether or not the proposal is likely to **accelerate the extinction of the species, population or ecological community or place it at risk of extinction**
- whether or not the proposal will **adversely affect critical habitat**.

This Chapter outlines how the proposal is assessed against these key thresholds.

7.1.1 Maintain or improve biodiversity values

Vegetation in the study area composed a mosaic woodland patches interspersed with cleared grazing country, as well as riparian woodland along the Namoi and Peel Rivers. Five vegetation communities were identified in the study area including White Box Yellow Box Blakely's Red Gum Woodland, an Endangered Ecological Community listed under the *Environment Protection and Biodiversity Conservation Act* 1999 and the *Threatened Species Conservation Act 1995*. Approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of the community is proposed for clearing for construction of Options B1, D2 and D3 respectively. The proposal includes clearing of an Endangered Ecological Community (White Box Yellow Box Blakely's Red Gum Woodland), threatened species and their habitats. As such, the proposal would not fulfil the objective to maintain or improve biodiversity values.

Maintenance or improvement of native vegetation can be achieved through offsets by commensurate long-term gains from revegetation or management (NSW Department of Natural Resources 2005). Biodiversity offsets strategies investigated for the Keepit Dam Upgrade are discussed in *Section 5.1.3* of the Environmental Assessment.

7.1.2 Long-term viability of a local population of the species, population or ecological community

Clearance of vegetation would increase edge effects to adjacent areas of woodland, however, this is unlikely to significantly impact the condition of these remnants. The proposed clearing would not significantly alter environmental conditions of adjacent habitats. Although there would be some fragmentation of habitats, this is unlikely to be significant, result in isolation of habitats or prevent wildlife movement.

The long term viability of local populations is unlikely to be significantly affected. However, the proposal would clear a significant area of White Box Yellow Box Blakely's Red Gum Woodland and would threaten the local occurrence of this community.

7.1.3 Risk of extinction of species, population or ecological community

Two Threatened species of plant have been recorded within the study area: *Hakea pulvinifera* and *Bothriochloa biloba.* A further four have potential habitat within the study area: *Diuris tricolor, Goodenia macbarronii, Swainsona murrayana* and *Digitaria porrecta.* The assessment of impact of the proposal on these species concluded that the proposal was unlikely to have a significant impact on these threatened species of plant because:

- the habitat within the construction footprint is disturbed and provides only marginal habitat and only a small amount of habitat would be cleared for construction (up to 49.8 hectares)
- although operational impacts including erosion, sedimentation and destruction of plants or habitat may affect these species, the frequency of occurrence of the flood events is very low.

Two Threatened species of animal have been recorded in the study area during the field surveys: Speckled Warbler and Yellow-bellied Sheathtail Bat. Other Threatened species including, parrots; honeyeaters; ground-dwelling insectivorous and granivorous birds; bats and Koalas are also likely to use habitats in the study area. The potential impacts to these species were assessed and concluded that the proposal was unlikely to have a significant impact.

For these reasons the proposal is unlikely to result in the extinction of threatened species.

The proposal would require clearing of White Box Yellow Box Blakely's Red Gum Woodland, a Threatened ecological community (Department of the Environment and Heritage 2006d; NSW Scientific Committee 2002; Threatened Species Scientific Committee 2006). The objectives for the recovery of this community are to prevent further loss or fragmentation and to increase the extent and ecological integrity of White Box Yellow Box Blakely's Red Gum Woodland (Department of Environment and Heritage 2004). The proposal includes the loss of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares fragments of this community for Options B1, D2 and D3 respectively and as such is not consistent with the recovery plan for this community. The proposal would have a significant impact on the community and its recovery.

7.1.4 Adversely affect critical habitat

No critical habitat is listed as occurring within the study area. The study area is not considered to be critical for the survival of any Threatened species or population. However, all areas of White Box Yellow Box Blakely's Red Gum Woodland should be considered to be potentially critical for the survival of this community (Department of Environment and Heritage 2004). Although the site is not listed as critical habitat, important areas of habitat for this community would be affected.

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Attachment A

Species of plant recorded within the locality

Attachment A Species of plant recorded within the study area

This attachment details the species of plant recorded within the study area during the current surveys.

Family	Scientific name	Common name	Native[1]
Adiantaceae	*Cheilanthes sieberi*	Mulga Fern	Y
Amaranthaceae	*Alternanthera pungens*	Khaki Weed	N
Anacardiaceae	*Schinus areira*	Pepper Tree	N
Asclepiadaceae	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush	N
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	N
	Bracteantha bracteata	Golden Everlasting	Y
	Calotis lappulacea	Yellow Burr-daisy	Y
	Centaurea melitensis	Maltese Cockspur	N
	Centaurea solstitialis	St Barnabys Thistle	N
	Chrysocephalum apiculatum	Common Everlasting	Y
	Conyza bonariensis	Flaxleaf Fleabane	N
	Conyza parva		N
	Conyza sumatrensis		N
	Silybum marianum	Variegated Thistle	N
	Sonchus oleraceus	Common Sowthistle	N
	Taraxacum officinale	Dandelion	N
	Vittadinia cuneata var. hirsuta		Y
	Vittadinia muelleri		Y
	Vittadinia sp.		Y
	Vittadinia sulcata		Y
	Xanthium occidentale	"Noogoora Burr, Cockle Burr"	N
Bignoniaceae	*Jacaranda mimosifolia*	Jacaranda	N
Boraginaceae	*Echium plantagineum*	Patterson's Curse	N
Brassicaceae	*Brassica sp.*		N
	Lepidium africanum		N
Buddlejaceae	*Buddleja davidii*		N
Cactaceae	*Cylindropuntia sp.*	Walking Stick Cactus	N
	Opuntia aurantiaca	Tiger Pear	N
	Opuntia stricta	Prickly Pear	N
Campanulaceae	*Wahlenbergia communis*	Tufted Bluebell	Y
Caryophyllaceae	*Petrorhagia nanteuilii*		N
Casuarinaceae	*Casuarina cunninghamiana*	River Oak	Y
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	Y
	Einadia polygonoides		Y
	Maireana microphylla		Y
	Salsola kali		Y
	Sclerolaena birchii	Galvinized Burr	Y

Family	Scientific name	Common name	Native[1]
	Sclerolaena muricata	Black Rolypoly	Y
Convolvulaceae	*Convolvulus erubescens*		Y
	Dichondra sp.		Y
	Evolvulus alsinoides		Y
Cupressaceae	*Callitris glaucophylla*	White Cypress Pine	Y
	Cupressus sp.		N
Cyperaceae	*Eleocharis pallens*		Y
Euphorbiaceae	*Chamaesyce dallachyana*		Y
	Chamaesyce drummondii	Caustic Weed	Y
	Phyllanthus virgatus		Y
Fabaceae (Faboideae)	*Glycine tabacina*		Y
	Medicago polymorpha	Burr Medic	N
	Swainsona sp.		Y
	Trifolium repens	White Clover	N
Fabaceae (Mimosoideae)	*Acacia decora*	Western Golden Wattle	Y
	Acacia pendula	Myall	Y
	Acacia subulata	Awl-leaved Wattle	Y
	Acacia venulosa		Y
Geraniaceae	*Geranium solanderi*	Native Geranium	Y
	Geranium sp.		Y
Lamiaceae	*Marrubium vulgare*	Horehound	N
	Mentha diemenica	Slender Mint	Y
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	Y
	Lomandra multiflora		Y
Malvaceae	*Pavonia hastata*		N
	Sida corrugata	Variable Sida	Y
	Sida cunninghamii		Y
	Sida sp.		Y
Myoporaceae	*Eremophila debilis*	Montanum	Y
Myrtaceae	*Angophora floribunda*	Rough-barked Apple	Y
	Eucalyptus albens	White Box	Y
	Eucalyptus blakelyi	Blakely's Red Gum	Y
	Eucalyptus camaldulensis	River Red Gum	Y
	Eucalyptus melanophloia	Silver-leaved Ironbark	Y
	Eucalyptus melliodora	Yellow Box	Y
	Eucalyptus populnea ssp. bimbil	Bimble Box	Y
Nyctaginaceae	*Boerhavia dominii*	Tarvine	Y
Oleaceae	*Notelaea lmicrocarpa*	Native Olive	Y
Oxalidaceae	*Oxalis perennans*		Y
Pinaceae	*Pinus sp.*		N
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn	Y

Family	Scientific name	Common name	Native[1]
Poaceae	*Aristida calycina*		Y
	Aristida caput-medusae	Many-headed Wiregrass	Y
	Aristida ramosa		Y
	Aristida vagans	Threeawn Speargrass	Y
	Austrostipa verticillata		Y
	Avena fatua	Wild Oats	N
	Bothriochloa biloba		Y
	Bothriochloa decipiens	Red Grass	Y
	Bothriochloa ewartiana	Desert Bluegrass	Y
	Bothriochloa macra	Red Grass	Y
	Chloris ventricosa	Tall Chloris	Y
	Chloris virgata	Feathertop Rhodes Grass	N
	Cymbopogon refractus	Barbed Wire Grass	Y
	Cynodon dactylon	Common Couch	Y
	Dichanthium sericeum	Queensland Bluegrass	Y
	Dichanthium sp.		Y
	Digitaria brownii	Cotton Panic Grass	Y
	Enneapogon nigricans	Niggerheads	Y
	Eragrostis leptostachya	Paddock Lovegrass	Y
	Eulalia aurea	Silky Browntop	Y
	Sporobolus creber	Slender Rat's Tail Grass	Y
	Themeda australis	Kangaroo Grass	Y
Polygonaceae	*Rumex brownii*	Swamp Dock	Y
Proteaceae	*Grevillea robusta*	Silky Oak	N
	Grevillea striata	Beefwood	N
	Hakea pulvinifera		Y
Ranunculaceae	*Ranunculus sp.*		Y
Rutaceae	*Geijera parviflora*	Wilga	Y
Salicaceae	*Salix babylonica*	Weeping Willow	N
Sapindaceae	*Dodonaea viscosa*		Y
Scrophulariaceae	*Verbascum thapsus*	Blanket Weed	N
Sterculiaceae	*Brachychiton populneus*	Kurrajong	Y
Urticaceae	*Urtica incisa*	Stinging Nettle	Y

Key: 1) N= no, not a native species or not naturally occurring in the local region; Y= yes, native to the local region

Attachment B

Threatened species of plant recorded within the locality

Attachment B Threatened species of plant recorded or likely to occur within the locality

This attachment details the threatened species of plant, sourced from Bionet, the Department of Environment and Conservation's *Atlas of NSW Wildlife* and the Department of the Environment and Heritage's Protected Matters Search Tool that have either been recorded or have the potential to occur within the locality.

Scientific name	**Common name**	**Recorded in locality[1]**	**TSC Act[2]**	**EPBC Act[3]**	**ROTAP[4]**	**Habitat**	**Likely to occur[4]**
Bothriochloa biloba		Yes, within 1 km		V	3V	Has a widespread distribution and grows in woodland on poorer soils (Harden 1993). Occurs on basaltic hills and grassland on drainage slopes on a variety of soils in association with *Eucalyptus punctata, E. albens*, *E.camaldulensis E. tereticornis, E. populnea ssp bimbil* and *Angophora floribunda* (DLWC, 2001).	Yes, recorded
Cadellia pentastylis		No	V	V	3Ra	Occurs west from near Tenterfield and north from Terry Hie (Royal Botanic Gardens 2006). Grows mainly in vine thickets or dry rainforest, and more rarely occurs in woodlands. It is a relict rainforest species and tends to favour upper and mid slope positions, often with a northerly aspect. It commonly occurs on sandy-loam to clay soils of low to medium fertility. It can occur in pure stands or in a mixed community on the slopes of residual sandstone ranges and scarps (Department of Environment and Conservation 2006).	No. Preferred habitat not present
Dichanthium setosum		No	V	V		Grows in woodland and grassland (Harden 1993). On the New England Tablelands and North West Slopes it grows on stony red-brown hard-setting soils over basalt, or on black soil (Department of Environment and Conservation 2006).	Yes, potential habitat within study area
Digitaria porrecta		No	E1	E	3E	In NSW it occurs in north western slopes and north western plains subdivisions (Royal Botanic Gardens 2006) where it grows in native grassland, woodlands or open forest with a grassy understorey, on richer soils. It is often found along roadsides and travelling stock routes where there is light grazing and occasional fire (Department of Environment and Conservation 2006).	Yes, potential habitat within study area
Diuris tricolor		No	V	V	3K	Grows in sclerophyll forest among grass, often with Callitris (Royal Botanic Gardens 2006) or in grassy Callitris woodland (Bishop 2000; Department of Environment and Conservation 2006). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW. Soils include gritty orange-brown loam on granite, shallow red loamy sand on stony porphyry, skeletal lateritic soil and alluvial grey silty loam. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats (Department of Environment and Conservation 2006). Within the Upper Hunter it is known to occur in *Eucalyptus albens/Eucalyptus crebra/Eucalyptus blakelyi/Corymbia maculata* woodland complexes and grasslands (Parsons Brinckerhoff 2004).	Yes, potential habitat within study area
Goodenia macbarronii	Narrow Goodenia	No	V	V	3V	Occurs south from Guyra and Inverell districts where it grows in damp sandy soils(Royal Botanic Gardens 2006). It grows in damp sandy soils in seepages. The species is usually found in shaded, seasonally damp sites in clay-loam, sandy-loam and sandy soils. Habitats in NSW include a recently graded roadside drain adjacent to Eucalyptus crebra and Callitris glaucophylla woodland, dry eucalypt forest with low shrubby undergrowth in sandy soil, damp sandy patches in bushland areas, along roadsides, near water in a shallow excavation which has exposed the clay subsoil, on the banks of a sandy creek and in *Eucalyptus blakelyi* and *Angophora floribunda* woodland. Sites often have some form of recent disturbance, such as depressions made by grading and excavation along roadsides. Other sites include grazed paddocks and clearings with a large proportion of weed and exotic species, and cleared open grazing land which was formerly eucalypt woodland (Department of Environment and Conservation 2005).	Yes, potential habitat within study area
Hakea pulvinifera		Yes, within 1 km	E1	E	2Ei	Known from single population near Namoi River below Keepit Dam where it grows on a hard rocky hillside (Department of Environment and Conservation 2006; Royal Botanic Gardens 2006).	Yes, recorded
Homopholis belsonii		No		V	3R	Occurs north from the Warialda district. It grows in dry woodland on poor soils such as belah (Department of Environment and Conservation 2006; Royal Botanic Gardens 2006)	No. Preferred habitat not present
Philotheca ericifolia		No	V	V	3R	Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies, in the upper Hunter Valley and Pilliga to Peak Hill district(Royal Botanic Gardens 2006). It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Associated species include *Melaleuca uncinata, Eucalyptus*	No. Preferred habitat not present

Scientific name	Common name	Recorded in locality[1]	TSC Act[2]	EPBC Act[3]	ROTAP[4]	Habitat	Likely to occur[4]
						crebra, E. rossii, E. punctata, Corymbia trachyphloia, Acacia triptera, A. burrowii, Beyeria viscosa, Philotheca australis, Leucopogon muticus and *Calytrix tetragona*. Noted as being a moisture-loving plant, with plants common on the sides of a particular spur of the Hervey Ranges where soakage from the high background provides sufficient moisture for the plants (Department of Environment and Conservation 2005).	
Pterostylis cobarensis		No	V	V	3V	Grows among rocks on low hills and on slopes above streams; chiefly from Nyngan to Bourke district (Royal Botanic Gardens 2006). Western plains of NSW, chiefly in Nyngan - Cobar - Bourke region; favours stony ridges, often growing under *Eucalyptus morisii* (Grey Mallee) (Bishop 2000). Habitats are eucalypt woodlands, open mallee or Callitris shrublands on low stony ridges and slopes in skeletal sandy-loam soils. It has been recorded from ridge tops as well as steep exposed slopes and sheltered east slopes. Soils include shallow red clay-loam, skeletal red loam on metaquartzite, shallow sandy-loam on conglomerate and sandstone, and skeletal gritty organic loam on microgranite. Associated species include *Eucalyptus morrisii, E. viridis, E. intertexta, E. vicina, Callitris glaucophylla, Geijera parviflora, Casuarina cristata, Acacia doratoxylon, Senna* spp. and *Eremophila* spp. (Department of Environment and Conservation 2006).	No. Preferred habitat not present
Swainsona murrayana	Slender Darling Pea	No	V	V	3Vi	Often grows with Maireana species on heavy soils, especially in depression (Royal Botanic Gardens 2006). Found throughout NSW, it has been recorded in the Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree. It grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with Maireana species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated. The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. The species may require some disturbance and has been known to occur in paddocks that have been moderately grazed or occasionally cultivated (Department of Environment and Conservation 2005).	Yes, potential habitat within study area
Thesium australe	Austral Toadflax	No	V	V	3Vi	Grows in grassland or woodland often in damp sites. It is a semi-parasitic herb and hosts are likely to be *Themeda australis* and *Poa* spp. (Harden 1992).	No. Preferred habitat not present
Tylophora linearis		No	E1	E	3E	Grows in dry scrub in the Barraba, Mendooran, Temora and West Wyalong districts, in the NWS, CWS botanical subdivisions(Royal Botanic Gardens 2006). Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa, E. sideroxylon, E. albens, Callitris endlicheri, C. glaucophylla and Allocasuarina luehmannii*. Also grows in association with *Acacia hakeoides, A. lineata, Myoporum species and Casuarina* species (Department of Environment and Conservation 2005).	No. Preferred habitat not present

Notes:

1. Yes= Recorded in the locality (based on Wildlife Atlas); No= predicted to occur (based on EPBC Protected Matter Search Tool)
2. V= Vulnerable, E1 = Endangered (*Threatened Species Conservation Act 1995*)
3. V = Vulnerable, E = Endangered (*Environment Protection and Biodiversity Conservation Act 1999*)
4. ROTAP (Rare or Threatened Australian Plants, Briggs and Leigh 1996) is a conservation rating for Australian plants. Codes are:
   - 2 Species with a geographic range of less than 100km in Australia
   - 3 Species with a geographic range of more than 100km in Australia
   - E Endangered species at risk of disappearing from the wild state if present land use and other causal factors continue to operate
   - V Vulnerable species at risk of long-term disappearance through continued depletion.
   - R Rare, but not currently considered to be endangered.
   - K Poorly known species that are suspected to be threatened.
   - C Known to be represented within a conserved area.
   - a At least 1,000 plants are known to occur within a conservation reserve(s).
   - i Less than 1,000 plants are known to occur within a conservation reserve(s).
   - - The reserved population size is unknown.

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Attachment C

Species of animal recorded within the study area

Attachment C Species of animal recorded within the study area

This attachment details the species of animal recorded within the study area during the current surveys.

Common Name	Latin Name	Observation Type[1]	TSC Act[2]	EPBC Act[3]
Amphibians				
Peron's Tree Frog	*Litoria peronii*	L		
Eastern Banjo Frog	*Limnodynastes dumerilii*	L		
Ornate Burrowing Frog	*Limnodynastes ornatus*	L		
Spotted Grass Frog	*Limnodynastes tasmaniensis*	O		
Reptiles				
Bearded Dragon	*Pogona barbata*	L		
Dubious Dtella	*Gehyra dubia*	L		
Eastern Blue-tongued Lizard	*Tiliqua scincoides*	L		
Striped Skink	*Ctenotus robustus*	L		
Tree Skink	*Egernia striolata*	L		
Eastern Long-necked Tortoise	*Chelodina longicollis*	O		
Boulenger's Skink	*Morethia boulengeri*	O		
Native birds				
Little Eagle	*Hieraaetus morphnoides*	O		M
Wedge-tailed Eagle	*Aquila audax*	O		M
Whistling Kite	*Haliastur sphenurus*	O		M
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	O		M
Grey Teal	*Anas gracilis*	O		M
Musk Duck	*Biziura lobata*	L		M
Darter	*Anhinga melanogaster*	O		
White-browed Woodswallow	*Artamus superciliosus*	L		
Galah	*Cacatua roseicapilla*	O		
Little Corella	*Cacatua sanguinea*	O		
Sulphur-crested Cockatoo	*Cacatua galerita*	O		
Varied Triller	*Lalage leucomela*	L		
Australian Raven	*Corvus coronoides*	O		
Mistletoebird	*Dicaeum hirundinaceum*	O		
Willie Wagtail	*Rhipidura leucophrys*	O		
Australian Hobby	*Falco longipennis*	O		M
Black Falcon	*Falco subniger*	L		M
Brown Falcon	*Falco berigora*	O		M
Welcome Swallow	*Hirundo neoxena*	O		
Caspian Tern	*Sterna caspia*	L		
Silver Gull	*Larus novaehollandiae*	O		

Common Name	Latin Name	Observation Type[1]	TSC Act[2]	EPBC Act[3]
Whiskered Tern	*Chlidonias hybridus*	O		
Variegated Fairy-wren	*Malurus lamberti*	O		
Noisy Miner	*Manorina melanocephala*	O		
White-plumed Honeyeater	*Lichenostomus penicillatus*	O		
Grey Shrike-thrush	*Colluricincla harmonica*	O		
Rufous Whistler	*Pachycephala rufiventris*	L		
Speckled Warbler	*Pyrrholaemus sagittatus*	O	V	
Yellow Thornbill	*Acanthiza nana*	O		
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	O		
Zebra Finch	*Taeniopygia guttata*	O		
Jacky Winter	*Microeca fascinans*	O		
Little Black Cormorant	*Phalacrocorax sulcirostris*	O		
Little Pied Cormorant	*Phalacrocorax melanoleucos*	O		
Pied Cormorant	*Phalacrocorax varius*	O		
Brown Quail	*Coturnix ypsilophora*	O		
Australasian Grebe	*Tachybaptus novaehollandiae*	O		
Great Crested Grebe	*Podiceps cristatus*	O		
Grey-crowned Babbler	*Pomatostomus temporalis*	L	V	
Pale-headed Rosella	*Platycercus adscitus*	L		
Red-rumped Parrot	*Psephotus haematonotus*	O		
Black-winged Stilt	*Himantopus himantopus*	L		M
Common Greenshank	*Tringa nebularia*	L		M
Black-shouldered Kite	*Elanus axillaris*	O		M
Brown Goshawk	*Accipiter fasciatus*	O		M
Grey Goshawk	*Accipiter novaehollandiae*	O		M
Azure Kingfisher	*Alcedo azurea*	O		
Australian Wood Duck	*Chenonetta jubata*	O		M
Black Swan	*Cygnus atratus*	O		M
Hardhead	*Aythya australis*	O		M
Pacific Black Duck	*Anas superciliosa*	O		M
White-throated Needletail	*Hirundapus caudacutus*	O		M
Great Egret	*Ardea alba*	O		
Little Egret	*Egretta garzetta*	O		
White-faced Heron	*Egretta novaehollandiae*	O		
Australian Magpie	*Gymnorhina tibicen*	O		
Grey Butcherbird	*Cracticus torquatus*	O		
Pied Butcherbird	*Cracticus nigrogularis*	O		
Pied Currawong	*Strepera graculina*	O		
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O		
Emu	*Dromaius novaehollandiae*	O		
Banded Lapwing	*Vanellus tricolor*	O		M

Common Name	Latin Name	Observation Type[1]	TSC Act[2]	EPBC Act[3]
Black-fronted Dotterel	*Elseyornis melanops*	O		M
Masked Lapwing	*Vanellus miles*	O		M
Bar-shouldered Dove	*Geopelia humeralis*	O		
Crested Pigeon	*Ocyphaps lophotes*	O		
Peaceful Dove	*Geopelia striata*	O		
Apostlebird	*Struthidea cinerea*	O		
White-winged Chough	*Corcorax melanorhamphos*	O		
Grey Fantail	*Rhipidura fuliginosa*	O		
Magpie-lark	*Grallina cyanoleuca*	O		
Restless Flycatcher	*Myiagra inquieta*	O		
Nankeen Kestrel	*Falco cenchroides*	O		M
Laughing Kookaburra	*Dacelo novaeguineae*	O		
Fairy Martin	*Hirundo ariel*	O		
Tree Martin	*Hirundo nigricans*	O		
White-backed Swallow	*Cheramoeca leucosternus*	O		
Superb Fairy-wren	*Malurus cyaneus*	O		
Brown-headed Honeyeater	*Melithreptus brevirostris*	O		
Fuscous Honeyeater	*Lichenostomus fuscus*	O		
Little Friarbird	*Philemon citreogularis*	O		
Noisy Friarbird	*Philemon corniculatus*	O		
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	O		
Striped Honeyeater	*Plectorhyncha lanceolata*	O		
White-eared Honeyeater	*Lichenostomus leucotis*	O		
Yellow-faced Honeyeater	*Lichenostomus chrysops*	O		
Rainbow Bee-eater	*Merops ornatus*	O		M
Richard's Pipit	*Anthus novaeseelandiae*	O		
Rufous Songlark	*Cinclorhamphus mathewsi*	O		M
Golden Whistler	*Pachycephala pectoralis*	O		
Buff-rumped Thornbill	*Acanthiza reguloides*	O		
Inland Thornbill	*Acanthiza apicalis*	O		
Striated Pardalote	*Pardalotus striatus*	W		
Weebill	*Smicrornis brevirostris*	O		
Western Gerygone	*Gerygone fusca*	O		
White-browed Scrubwren	*Sericornis frontalis*	O		
White-throated Gerygone	*Gerygone olivacea*	O		
Double-barred Finch	*Taeniopygia bichenovii*	O		
Red-browed Finch	*Neochmia temporalis*	O		
Australian Pelican	*Pelecanus conspicillatus*	O		
Eastern Yellow Robin	*Eopsaltria australis*	O		
Red-capped Robin	*Petroica goodenovii*	O		
Great Cormorant	*Phalacrocorax carbo*	O		

Common Name	Latin Name	Observation Type[1]	TSC Act[2]	EPBC Act[3]
Stubble Quail	*Coturnix pectoralis*	O		
Tawny Frogmouth	*Podargus strigoides*	W		
Australian King-Parrot	*Alisterus scapularis*	O		
Eastern Rosella	*Platycercus eximius*	O		
Little Lorikeet	*Glossopsitta pusilla*	O		
Cockatiel	*Nymphicus hollandicus*	O		
Dusky Moorhen	*Gallinula tenebrosa*	O		
Eurasian Coot	*Fulica atra*	O		
Purple Swamphen	*Porphyrio porphyrio*	O		
Australian White Ibis	*Threskiornis molucca*	O		
Royal Spoonbill	*Platalea regia*	O		
Yellow-billed Spoonbill	*Platalea flavipes*	O		
Painted Button-quail	*Turnix varia*	O		
Silvereye	*Zosterops lateralis*	O		
Introduced birds				
Common Blackbird	*Turdus merula*	O	U	M
House Sparrow	*Passer domesticus*	O	U	
Common Starling	*Sturnus vulgaris*	O	U	
Native mammals				
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	W	V	
Common Wallaroo	*Macropus robustus*	O		
Eastern Grey Kangaroo	*Macropus giganteus*	O		
White-striped Mastiff-bat	*Nyctinomus australis*	W		
Short-beaked Echidna	*Tachyglossus aculeatus*	L		
Chocolate Wattled Bat	*Chalinolobus morio*	W		
Swamp Wallaby	*Wallabia bicolor*	O		
Common Brushtail Possum	*Trichosurus vulpecular*	O		
Introduced Mammals				
Brown Hare	*Lepus capensis*	O	U	
Rabbit	*Oryctolagus cuniculus*	O	U	
Fox	*Vulpes vulpes*	O	U	
Cat (feral)	*Felis catus*	P	U	

Notes

1) O = Observed, P = Indirect Evidence, W= Heard call, L = Literature (Atlas of NSW Wildlife)

2) U= Unprotected, V= Vulnerable (*Threatened Species Conservation Act 1995*)

3) M= Migratory (*Environment Protection and Biodiversity Conservation Act 1999*)

Attachment D

Threatened species of animal recorded within the locality

Attachment D Threatened and migratory species of animal recorded or likely to occur within the locality

This attachment details the threatened and migratory species and populations of animals that have either been recorded in the local area, or that have the potential to occur, based on the NPWS Department of Environment and Conservation's *Atlas of NSW Wildlife* and the Department of the Environment and Heritage's Protected Matters Search Tool.

Common name	Scientific Name	*Recorded within the locality*[1]	*TSC Act*[2]	*FM Act*[2]	*EPBC Act*[3]	Habitat	Likely to occur within site
Amphibians							
Booroolong Frog	*Litoria booroolongensis*	No	E1			Confined to mountain streams of the Great Dividing Range (Cogger 2000). Usually found on or under boulders and debris in and beside the rocky beds of mountain streams; breeds in summer (Anstis 2002).	Low. The species has not been recorded in the study area.
Tusked Frog	*Adelotus brevis*	No	E2			The species inhabits coastal forests and adjacent ranges from Ourimbah, NSW to Eungella, QLD. Males construct nest in concealed sites under leaf litter, vegetation or logs in shallow water at the edge of ponds or stream pools. Nests may also be in water-filled depressions such as those made by yabbies or cattle hooves (Anstis 2002).	Low. The species has not been recorded in the study area.
Native Birds							
Brown Treecreeper	*Climacteris picumnus*	Yes, within 10 km	V			Occurs in eucalypt woodland and adjoining vegetation. Feeds on ants, beetles and larvae on trees and from fallen timber and leaf litter. Usually nests in hollows (Garnett & Crowley 2000).	Moderate. Suitable habitat exists in the study area.
Painted Honeyeater	*Grantiella picta*	Yes, within 20 km	V			Lives in dry forests and woodlands. Primary food is the mistletoes in the genus *Amyema*, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett & Crowley 2000).	Moderate. Suitable habitat exists in the study area.
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	No			M	Occurs in coastal areas including islands, estuaries, inlets, large rivers, inland lakes and reservoirs. Builds a huge nest of sticks in tall trees near water, on the ground on islands or on remote coastal cliffs (Pizzey & Knight 1997).	High. The species was observed nesting within a dead tree in the dam. However, habitat within the study locality would not be considered 'important habitat' as defined under the *EPBC Act*.

Common name	Scientific Name	*Recorded within the locality*[1]	*TSC Act*[2]	*FM Act*[2]	*EPBC Act*[3]	Habitat	Likely to occur within site
White-throated Needletail	*Hirundapus caudacutus*	No			M	Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April (Pizzey & Knight 1997).	High. The species was recorded during field surveys. Habitat within the study locality would not be considered 'important habitat' as defined under the *EPBC Act*.
Swift Parrot	*Lathamus discolor*	No	E1		EM	Breeding occurs in Tasmania, majority migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. Until recently it was believed that in New South Wales, swift parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region, but new evidence indicates that the forests on the coastal plains from southern to northern NSW are also extremely important. In mainland Australia is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants, and for sites with flowering Acacia pycnantha, is indicated. Sites used vary from year to year. (Garnett & Crowley 2000),(Swift Parrot Recovery Team 2001).	Moderate- the study area contains marginal foraging habitat for the species. This species does not breed in NSW. Habitat within the study locality would not be considered 'important habitat' as defined under the *EPBC Act*.
Hooded Robin	*Melanodryas cucullata*	Yes, within 10 km	V			Found in south-eastern Australia, generally east of the Great Dividing Range. Found in eucalypt woodland and mallee and acacia shrubland. This is one of a suite of species that has declined in woodland areas in south-eastern Australia (Garnett & Crowley 2000; Traill & Duncan 2000).	Moderate- High. The species has been recorded in the study area and suitable habitat is present.
Black-chinned Honeyeater	*Melithreptus gularis gularis*	Yes, within 30 km	V			Found in dry eucalypt woodland particularly those containing ironbark and box. Occurs within areas of annual rainfall between 400-700 mm. Feed on insects, nectar and lerps (Garnett & Crowley 2000).	Moderate- High. The species has been recorded in the study area and suitable habitat is present.
Satin Flycatcher	*Myiagra cyanoleuca*	No			M	Occurs in heavily vegetated gullies, in forests and taller woodlands. During migration it is found in coastal forests, woodlands, mangroves, trees in open country and gardens (Pizzey & Knight 1997).	Occasionally. The species has been recorded in the study area. Habitat within the study locality would not be considered 'important habitat' as defined under the EPBC Act.

Common name	Scientific Name	*Recorded within the locality*[1]	*TSC Act*[2]	*FM Act*[2]	*EPBC Act*[3]	Habitat	Likely to occur within site
Turquoise Parrot	*Neophema pulchella*	Yes, within 10 km	V			Occurs in the foothills of the great dividing range in eucalypt woodlands and forests with a grassy or sparsely shrubby understorey. Nests in hollows in trees, stumps or even fence posts. It feeds on seeds of both native and introduced grass and herb species (Garnett & Crowley 2000).	Moderate to high- the study area contains suitable foraging habitat for the species, however, the species has been previously recorded on site.
Superb Parrot	*Polytelis swainsonii*	No	V		V	Mainly found in the Riverina where they nest in loose colonies in riparian woodland on River Red Gum. On the inland slopes, Superb Parrots both forage and feed within box woodland, mostly nesting in dead trees (Garnett & Crowley 2000).	Low. This species may use riparian habitats of the Namoi and Peel rivers for foraging and breeding. It has been previously recorded in the upper reaches of the Namoi outside the project locality.
Grey-crowned Babbler	*Pomatostomus temporalis*	Yes, within 10 km	V			Found throughout western slopes and plains, southern and central tablelands and occurring in Northern Rivers area, mid-north coast and the Hunter Valley of NSW. Lives in open forest and woodland, acacia shrubland and adjoining farmland. Large stick dome nest with spout-like entrance (Pizzey & Knight 1997).	Moderate- High. The species has been recorded in the study area and suitable habitat is present.
Speckled Warbler	*Pyrrholaemus sagittatus*	Yes	V			Occurs in a wide range of eucalypt dominated vegetation with a grassy understorey and is often found on rocky ridges or in gullies. It feeds on seeds and insects and builds domed nests on the ground (Garnett & Crowley 2000).	High. The species has been recorded in the study area and suitable habitat is present.
Painted Snipe	*Rostratula benghalensis*	No	E1		VM	Inhabits shallow, vegetated, temporary or infrequently filled wetlands, including where there are trees such as Eucalyptus camaldulensis (River Red Gum), E. populnea (Poplar Box) or shrubs such as Muehlenbeckia florulenta (Lignum) or Sarcocornia quinqueflora (Samphire). Feeds at the water's edge and on mudlflats on seeds and invertebrates, including insects, worms, molluscs and crustaceans. Males incubate eggs in a shallow scrape nest (Garnett & Crowley 2000).	Low. The species has not been recorded in the study area. Habitat within the study locality would not be considered 'important habitat' as defined under the *EPBC Act*.
Diamond Firetail	*Stagonopleura guttata*	Yes, within 5 km	V			Occurs in a range of eucalypt dominated communities with a grassy understorey including woodland, forest and mallee. Most populations occur on the inland slopes of the dividing range. Feed on seeds, mostly of grasses (Garnett & Crowley 2000).	Moderate- High. The species has been recorded in the study area and suitable habitat is present.

Common name	Scientific Name	*Recorded within the locality*[1]	*TSC Act*[2]	*FM Act*[2]	*EPBC Act*[3]	Habitat	Likely to occur within site
Masked Owl	*Tyto novaehollandiae*	Yes, within 20 km	V			Occurs within a diverse range of wooded habitats including forests, remnants and almost treeless inland plains. This species requires large-hollow bearing trees for roosting and nesting and nearby open areas for foraging. They typically prey on terrestrial mammals including rodents and marsupials but will also take other species opportunistically. Also known zto occasionally roost and nest in caves (Garnett & Crowley 2000).	Low- moderate. The species has not been recorded in the study although it may occasionally use the area for marginal foraging.
Regent Honeyeater	*Xanthomyza phrygia*	Yes, within 30 km	E1		EM	Occurs mostly in box-ironbark forests and woodland and prefers the wet, fertile sites such as along creek flats, broad river valleys and foothills. The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Important food trees include *Eucalyptus sideroxylon* (Mugga Ironbark), *E. albens* (White Box), *E. melliodora* (Yellow Box) and *E. leucoxylon* (Yellow Gum) (Garnett & Crowley 2000). Nesting sites occur in the canopy of forest or woodland, usually in the crowns of tall trees, mostly always in rough-barked trees. They sometimes nest in mistletoes (Higgins et al. 2001).	Moderate. This species has been recorded in the upper Manilla River 20 km north of Keepit Dam.
Australian Brush Turkey	*Alectura lathami*	No	E2			It occurs in forested and wooded areas of tropical and warm-temperate districts, particularly above 300 m to at least 1200 m altitude. Recent records for the species show the population to range from north east of Warialda, to Narrabri, approximately 115 km to the south-west, and occur within the local government areas of Yallaroi, Bingara, Narrabri, Barraba and Moree Plains. The majority of records are from Mount Kaputar National Park and nearby Deriah State Forest, with a smaller cluster of records from Warialda State Forest. In NSW the inland vegetation type preferred by the Australian Brush-turkey is a dry rainforest community that is found within the Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions Endangered Ecological Community.	Low. This species has not been previously recorded in the study area. Preferred vegetation types are absent.
Native Mammals							
Rufous Bettong	*Aepyprymnus rufescens*	No	V			Distribution: From Cooktown in north Queensland, to north-east NSW, where it occurs east of the Dividing Range. In Queensland, it still occurs on both sides of the Great Divide. Macrohabitat: Found in a variety of forest types from wet sclerophyll to dry open woodland, where grass tussocks or fallen timber are present. Also known to occupy a mosaic of open forest and grasslands. Microhabitat: It appears to prefer a more open forest structure, with an sparse shrub layer and a diverse ground cover. Builds nests in grass tussocks and under logs. Strongly associated with dry sclerophyll forest particularly those dominated by Spotted Gum (NSW National Parks and Wildlife Service 1999a).	Low. The species has not been recorded in the study area.
Large-eared Pied Bat	*Chalinolobus dwyeri*	Yes, within 30 km	V		V	Occurs in moderately wooded habitats and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins. Thought to forage below the forest canopy for small flying insects (Churchill 1998).	Low. The species has not been recorded in the study area.

Common name	Scientific Name	*Recorded within the locality*[1]	*TSC Act*[2]	*FM Act*[2]	*EPBC Act*[3]	Habitat	Likely to occur within site
Little Pied Bat	*Chalinolobus picatus*	Yes, within 30 km	V			The species roosts in trees, caves, and abandoned mines and houses. Roost sites in caves are ususually warm and dry but they can tolerate roost temperatures of more than 40 degrees celsius. The Little Pied Bat has been recorded in dry open forest, open woodland, Mulga woodlands, chenopod shrublands, Callitris forest and mallee (Churchill 1998).	Moderate. The species has not been recorded in the study area; however, suitable habitat is present.
Spotted-tailed Quoll	*Dasyurus maculatus*	No	V		E	Occurs from the Bundaberg area in south-east Queensland, south through NSW to western Victoria and Tasmania. In NSW, it occurs on both sides of the Great Dividing Range and north-east NSW represents a national stronghold (NSW National Parks and Wildlife Service 1999a). Occurs in wide range of forest types, although appears to prefer moist sclerophyll and rainforest forest types, and riparian habitat. Most common in large unfragmented patches of forest. It has also been recorded from dry sclerophyll forest, open woodland and coastal heathland, and despite its occurrence in riparian areas, it also ranges over dry ridges. Nests in rock caves and hollow logs or trees. Feeds on a variety of prey including birds, terrestrial and arboreal mammals, small macropods, reptiles and arthropods (NSW National Parks and Wildlife Service 1999b, 1999a).	Low. The species has not been recorded in the study area; however. This species is unlikely to occur due to the fragmentation of suitable habitats.
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	Yes, within 30 km	V			Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings. Forages within the canopy of dry sclerophyll forest. It prefers wet habitats where trees are more than 20 metres high (Churchill 1998).	Moderate. Suitable foraging and breeding habitat is present.
Black-striped Wallaby	*Macropus dorsalis*	No	E1			The preferred habitats for the species is forested country with a dense shrub layer including rainforest margins; brigalow scrub, particularly in a phase of regrowth; open forest with a thick acacia or other shrub understorey; and lantana thickets (Strahan 1995).	Low. Suitable understorey habitats including dense shrub layer is absent in the study area.
Eastern Long-eared Bat (south-eastern form)	*Nyctophilus timoriensis*	No	V		V	Roosts in tree hollows and under loose bark in arid and semi-arid Australia (Strahan 1995).	Low- moderate. The species has not been officially recorded in the study area; however, suitable habitat is present.
Bridled Nailtail Wallaby	*Onychogalea fraenata*	Yes, within 30 km	E4		E	The species is recorded in habitats west of the Great Dividing Range in a mixture of tall shrubland and grassy woodland, and on the fertile soils which support open eucalypt forest and woodland, and brigalow scrub. The species has a preference for scrub edges and adjacent vegetation, grazing and sheltering in the shrubland and grazing the grassy woodland (Strahan 1995).	Low. The species has not been recorded in the study area. Suitable habitats are absent.

Common name	Scientific Name	*Recorded within the locality*[1]	*TSC Act*[2]	*FM Act*[2]	*EPBC Act*[3]	Habitat	Likely to occur within site
Squirrel Glider	*Petaurus norfolcensis*	Yes, within 30km	V			Found in dry sclerophyll forest and woodland but not found in dense coastal ranges. Nests in hollows and feeds on gum of acacias, eucalypt sap and invertebrates (NSW National Parks and Wildlife Service 1999c).	Low - moderate. The species has been recorded north of the study area.
Brush-tailed Rock-wallaby	*Petrogale penicillata*	No	E1		V	Occurs in inland and sub-coastal south eastern Australia where it inhabits rock slopes. It has a preference for rocks which receive sunlight for a considerable part of the day. Windblown caves, rock cracks or tumbled boulders are used for shelter. Occur in small groups or 'colonies' each usually separated by hundreds of metres (NSW National Parks and Wildlife Service 2003a).	Low. The species has not been recorded in the study area. Suitable habitats are absent.
Koala	*Phascolarctos cinereus*	Yes, within 30km	V			Found in sclerophyll forest. Throughout New South Wales, Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 non-eucalypt species. However, in any one area, Koalas will feed almost exclusively on a small number of preferred species. The preferred tree species vary widely on a regional and local basis. Some preferred species in NSW include Forest Red Gum Eucalyptus tereticornis, Grey Gum E. punctata, Monkey Gum E. cypellocarpa and Ribbon Gum E. viminalis. In coastal areas, Tallowwood E. microcorys and Swamp Mahogany E. robusta are important food species, while in inland areas White Box E. albens, Bimble Box E. populnea and River Red Gum E. camaldulensis are favoured (NSW National Parks and Wildlife Service 1999d, 2003b).	Low to moderate. The species has not been recorded in the study area, however, suitable habitat is present.
Plains Rat	*Pseudomys australis*	No	E4		V	The species lives in complex burrow systems dug into hard rock gibber or the softer soil built up around the bases of the stunted bushes on the inland slopes of the Great Dividing Range (Strahan 1995).	Low. Suitable habitats are absent.
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	Yes, within 5 km	V			Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts in tree hollows. Thought to be a migratory species (Churchill 1998).	High. The species has been recorded in the study area.
Reptiles							
Broader Thick-tailed Gecko	*Underwoodisaurus sphyrurus*	Yes, within 30 km	V		V	The species is closely associated with exfoliating low granite outcrops and rocky hills in Eucalypt woodland. The species has been recorded at the northern slopes and tablelands of NSW and adjacent border regions of southern QLD. Little is known about the species (Cogger 2000).	Low. The species has not been recorded in the study area, and the study area is south of the known distribution for the species.

Common name	Scientific Name	*Recorded within the locality*[1]	*TSC Act*[2]	*FM Act*[2]	*EPBC Act*[3]	Habitat	Likely to occur within site
Five-clawed Worm Skink	*Anomalopus mackayii*	No	E		V	The species occurs in open woodland with moist black soil, scattered eucalypts and cropped grass cover. The Smooth-scaled burrowing lizard is usually found under timber (Swan et al. 2004).	Low. The species has not been recorded in the study area. Soil type is unsuitable. Groundcover and marginal area habitat has been severely modified for agricultural crops.

Notes:

1. Locality= 30 km radius; Yes= Recorded in the locality (based on Wildlife Atlas); No= predicted to occur (based on EPBC Protected Matter Search Tool)
2. V= Vulnerable, E1 = Endangered, E4 = Presumed extinct, E2= Endangered Population (*Threatened Species Conservation Act 1995*, *Fisheries management Act 1994*)
3. V = Vulnerable, E = Endangered, M = Migratory, C = Conservation Dependent (*Environment Protection and Biodiversity Conservation Act 1999*).

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Attachment E

Accuracy of searched databases

Attachment E Accuracy of searched databases

This attachment details the types of data obtained from the Department of Environment and Conservation's *Atlas of NSW Wildlife* and the Department of the Environment and Heritage's Protected Matter Search Tool and the accuracy of both datasets.

Atlas of NSW Wildlife

The *Atlas of NSW Wildlife* is based on records of specific sightings. Each point is entered on a 1 kilometre grid and hence location is only accurate to within 1 kilometre. The Atlas is not based on systematic surveys across New South Wales and the number of records is generally biased towards coastal sites and areas where people commonly visit, such as national parks. It is also biased towards particular species, reserves and roads.

Protected Matters Search Tool

The Department of the Environment and Heritage's Protected Matters Search Tool is based on predicted distributions compiled from a number of sources at various resolutions. Generally, where distributions are well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and detailed habitat studies. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps. For species whose distributions are less well known, point locations are collated from various sources and bioclimatic distribution models generated and then validated by experts. In some cases, distribution maps are based solely on expert knowledge. For species where the distributions are well known, maps have been digitised from sources such as recovery plans and detailed habitat studies.

The following species and ecological communities have not been mapped and do not appear in reports produced from the database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- cetaceans which are not listed as threatened
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or occur only in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent.

Attachment F

Heads of consideration guidelines for threatened species assessment

Attachment F Heads of consideration guidelines for Threatened species assessment

This attachment details the heads of consideration for Threatened species assessment as specified in the Department of Environment and Conservation/ Department of Primary Industries *Draft Guidelines for Threatened Species Assessment* (Department of Environment and Conservation 2005). The guidelines require consideration as part of the project application under Part 3A of the *Environmental Planning and Assessment Act 1979.*

Head of consideration are used to assess potential impacts on threatened species, populations, or ecological communities, or their habitats for development applications. The objective of the assessment process is to provide information to enable decision makers to ensure that developments deliver the following environmental outcomes:

Maintain or improve biodiversity values (ie. there is no net impact on threatened species or native vegetation).

- Conserve biological diversity and promote ecologically sustainable development.
- Protect areas of high conservation value (including areas of critical habitat).
- Prevent the extinction of threatened species.
- Protect the long-term viability of local populations of a species, population or ecological community.
- Protect aspects of the environment that are matters of national environmental significance.

The assessment is designed to provide information and analysis to demonstrate that feasible alternatives have been considered, that the project has been designed to be consistent with the principles outlined above, and where there are impacts, that adequate mitigation measures are implemented.

Table 1: Identifying potential effects of the proposal on threatened species, populations or ecological communities, or their habitats (Department of Environment and Conservation 2005).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?
▪ displaces or disturbs threatened species and/or populations
▪ disrupts the breeding cycle
▪ disturbs the dormancy period
▪ disrupts roosting behaviour
▪ changes foraging behaviour
▪ affects migration and dispersal ability
▪ disrupts pollination cycle
▪ disturbs seedbanks
▪ disrupts recruitment (i.e. germination and establishment of plants)

- affects the interaction between threatened species and other species in the community (e.g. pollinators, host species, mychorrizal associations).

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

- disturbs any permanent, semi-permanent or ephemeral water bodies
- degrades soil quality
- clears or modifies native vegetation
- introduces weeds, vermin or feral species or provides conditions for them to increase and/or spread
- removes or disturbs key habitat features such as trees with hollows, caves and rock crevices, foraging habitat
- affects natural revegetation and recolonisation of existing species following disturbance

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

How is the proposal likely to affect current disturbance regimes?

- modifies the intensity and frequency of fires
- modifies flooding flows.

How is the proposal likely to affect habitat connectivity?

- creates a barrier to fauna movement
- removes remnant vegetation or wildlife corridors
- modifies remnant vegetation or wildlife corridors.

How is the proposal likely to affect critical habitat?

- removes or modifies key habitat features
- affects natural revegetation or recolonisation of existing species following disturbance
- introduces weeds, vermin or feral species
- generates or disposes of solid, liquid or gaseous waste
- uses pesticides, herbicides or other chemicals.

References

Department of Environment and Conservation 2005, *Draft guidelines for Threatened species assessment under Part 3A*, Department of Environment and Conservation, Hurstville.

Attachment G

Impact assessment

Attachment G Impact assessments

For Threatened biodiversity listed under the *Threatened Species Conservation Act 1995*, this section details the heads of consideration for Threatened species assessment as suggested in the Department of Environment and Conservation/ Department of Primary Industries draft *Guidelines for Threatened Species Assessment* (Department of Environment and Conservation 2005). The guidelines present methods to consider the impacts on biodiversity of projects assessed under Part 3A of *the Environmental Planning and Assessment Act 1979,* including presenting heads of consideration for determining the significance of impacts.

For Threatened biodiversity listed under the *Environment Protection and Biodiversity Conservation Act 1999* significance assessment have been completed in accordance with the *Environment Protection and Biodiversity Conservation Act 1999 Significant Impact Guidelines* (Department of the Environment and Heritage 2006).

Species listed under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999* have been assessed in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* Significant Impact Guidelines (Department of the Environment and Heritage 2006) in order to assess the significance of impacts.

The following threatened biodiversity have been assessed for the Proposal:

- White Box, Yellow Box, Blakely's Red Gum Woodland
- *Goodenia macbarronii*
- *Swainsona murrayana*
- *Bothriochloa biloba*
- *Digitaria porrecta*
- *Diuris tricolor*
- *Dichanthium setosum*
- *Hakea pulvinifera*
- Threatened woodland birds assessed together as a group (Brown Treecreeper, Painted Honeyeater, Hooded Robin, Black-chinned Honeyeater, Grey-crowned Babbler, Speckled Warbler and Diamond Firetail)
- Regent Honeyeater
- Swift Parrot
- Turquoise Parrot
- Microchiropteran bats considered as a group (Little Pied Bat, Eastern False Pipistrelle, Eastern Long-eared Bat, Yellow-bellied Sheathtail Bat)
- Koala.

White Box Yellow Box Blakely's Red Gum Woodland

White Box Yellow Box Blakely's Red Gum Woodland occurs within the study area and would be impacted by both construction and operational impacts. Derived grasslands are also protected under this listing. The majority of the grasslands within the study area occur on the foreshores of Keepit Dam and would be impacted by operational flooding. Based on elevation and remnant trees, the majority of these grasslands are likely to be remnants from Poplar Box Woodland and Silver-leaved Ironbark Woodland and as such have not been assessed below. However, it is likely that some of these grasslands would correspond to secondary White Box Yellow Box Blakely's Red Gum Woodland grasslands and that the assessment provided below would therefore be an underestimate of the impacts to this community.

White Box Yellow Box Blakely's Red Gum Grassy Woodland and derived native Grasslands is listed as a Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* and White Box Yellow Box Blakely's Red Gum Woodland is listed as Endangered under the *Threatened Species Conservation Act 1995.*

Is the action likely to reduce the extent of a community?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This vegetation within the footprint is generally highly disturbed and in poor condition. However, vegetation within the travelling stock reserve is in good condition and vegetation at the right-hand abutment although dominated by Callitris is in moderate condition.

Although operational impacts including erosion, sedimentation and destruction of plants resulting from flooding may impact this community, the probability of flooding is very low. Further, as a result of the upgrade, this flood occurrence is less likely to occur and is also likely to be less severe.

Is the action likely to fragment an occurrence of the community?

Within the study area White Box Yellow Box Blakely's Red Gum Woodland occurs as isolated remnants. However, even isolated trees can provide important links for fauna (NSW National Parks and Wildlife Service 2002a; NSW Scientific Committee 2002).

Although the majority of the proposed works are adjacent to existing clearings and infrastructure, clearing for construction would result in fragmentation of Woodland in the right-hand abutment area and in the travelling stock reserve (for an access track).

The proposal is likely to decrease connectivity.

Is the action likely to adversely affect habitat critical to the survival of an ecological community?

All areas of box woodland should be considered to be potentially critical for the survival of this community (Department of Environment and Heritage 2004). The proposal would include removal of some areas of habitat for construction. Although operational impacts including erosion, sedimentation and destruction of plants resulting from flooding may

impact this community, the probability of flooding is very low. Further, as a result of the upgrade, this flood occurrence is less likely to occur and is also likely to be less severe.

Is the action likely to modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for the community's survival?

Operational impacts include erosion and sedimentation in the event of a flood. This would result in the destruction of plants within this community. However, the probability of flooding is very low. Further, as a result of the upgrade, this flood occurrence is less likely to occur than currently and is also likely to be less severe.

Is the action likely to cause a substantial change in the species composition of an occurrence of an ecological community?

Construction impacts would be unlikely to substantially change the species composition of the community. Operational impacts include erosion and sedimentation in the event of a flood. This would result in the destruction of plants and is likely to result in the loss of more shallow rooted species.

Is the action likely to cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- ***assisting invasive species, that are harmful to the listed ecological community, to become established; and***

- ***causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community?***

The proposal would not result in mobilisation of fertilizers, herbicides or other chemicals or pollutants that would kill or inhibit the growth of species.

A small area of potential habitat within the travelling stock reserve would be cleared for an access track to construction areas. Construction in this area could result in invasion of introduced species into this area.

Mitigation measures have been provided to minimise the likelihood of weed invasion, particularly by noxious species. A weed management plan would be prepared and implemented for the construction and operational phases and would outline weed control and management measures for the project. This would include ensuring that vehicles, equipment, boots and clothing are clean of soil and seeds prior to entering or leaving a site. Following construction, disturbed areas would be revegetated with locally indigenous species and a weed control program implemented.

Through the development and implementation of a weed management plan for the project, the proposal is unlikely to result in significant invasion of weed species within the study area.

Is the action likely to interfere with the recovery of an ecological community?

The objectives for the recovery of this community are to prevent further loss or fragmentation and to increase the extent and ecological integrity of White Box Yellow Box Blakely's Red Gum Woodland (Department of Environment and Heritage 2004). The proposal includes the loss of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of this community and as such is not consistent with the recovery plan for this community.

Conclusion

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This clearing is not consistent with the objectives of the recovery plan for this community. The proposal is likely to have a significant impact on this community.

Diuris tricolor

Diuris tricolor is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* and under the *Threatened Species Conservation Act 1995*. It has a conservation rating of 3K meaning that it is a poorly known species suspected to be threatened and has a geographic range of more than 100 kilometres in Australia (Briggs & Leigh 1996).

Diuris tricolor is an annual ascending forb with leaves 20–30 centimetres long, and flowers on stalks 20–40 centimetres tall. Plants die back to tubers during the warmer months of the year, emerge and grow during the cooler months, and flower in spring.

The presence of *Diuris tricolor* on site cannot be confirmed without further targeted surveys during the flowering period. Further surveys for this species would be undertaken during its flowering period (September to November). The following assessments are based on the assumption that it is present.

Is the action likely to lead to a long-term decrease in the size of an important population of a vulnerable species?

Under the *Environment Protection and Biodiversity Conservation Act 1999*, important populations are:

- likely to be key source populations either for breeding or dispersal;
- likely to be necessary for maintaining genetic diversity; and/or
- at or near the limit of the species range.

Diuris tricolor has not been recorded within the study area. The nearest records are at Premer (80 kilometres to south west) and Narrabri (100 kilometres to north west) (pers comm. P. Spark). Due to disturbance through ongoing grazing, the site would provide only marginal habitat. If occurring within the study area, the population is unlikely to be a key source population or necessary for maintaining genetic diversity.

Diuris tricolor is known to occur in the northern and central tablelands of NSW, the northern and central western slopes of NSW, and Queensland (Harden 1993). The study area is not at the limit of distribution of this species.

If this species occurs within the study area, the population would be unlikely to be an important population. No known population occurs within the site and due to past and ongoing disturbance, including clearing, grazing and flooding, the site provides only marginal habitat for this species. The proposal is unlikely to result in the long-term decrease in a population, however, as a precaution, pre-clearing surveys during its flowering period have been recommended (September to November). If located within the site, impacts to individuals would be avoided or individuals relocated to suitable habitat nearby where possible.

Is the action likely to reduce the area of occupancy of an important population of a vulnerable species?

If this species occurs within the study area, the population would be unlikely to be an important population (see above). No known population occurs within the site and due to past and ongoing disturbance, including clearing, grazing and flooding, the site provides only marginal habitat for this species. The proposal would remove up to 48 hectares of marginal habitat. as a precaution, pre-clearing surveys during its flowering period have been recommended (September to November). If located within the site, impacts to individuals would be avoided or individuals relocated to suitable habitat nearby where possible.

Is the action likely to fragment an existing important population of a vulnerable species into two or more populations?

If this species occurs within the study area, the population would be unlikely to be an important population (see above). Although the majority of the proposed works are adjacent to existing clearings and infrastructure, clearing for construction would result in fragmentation of Woodland in the right-hand abutment area and in the travelling stock reserve (for an access track). The proposal is likely to decrease connectivity. However, no population of this species is known to occur in this area. As a precaution, pre-clearing surveys during its flowering period have been recommended (September to November). If located within the site, impacts to individuals and fragmentation of the population would be avoided or individuals relocated to suitable habitat nearby where possible.

Is the action likely to adversely affect habitat critical to the survival of a vulnerable species?

Diuris tricolor has not been recorded within the study area. The nearest records are at Premer (80 kilometres to south west) and Narrabri (100 kilometres to north west) (pers comm. P. Spark). Due to past and ongoing disturbance, including clearing, grazing and flooding, the site provides only marginal habitat and for this species. The study area is unlikely to contain habitat critical to the survival of this species.

Is the action likely to disrupt the breeding cycle of an important population of a vulnerable species?

If this species occurs within the study area, the population would be unlikely to be an important population (see above). No known population occurs within the site and due to past and ongoing disturbance, including clearing, grazing and flooding, the site provides only marginal habitat for this species. The proposal would remove up to 48 hectares of marginal habitat. As a precaution, pre-clearing surveys during its flowering period have been recommended (September to November). If located within the site, impacts to individuals would be avoided or individuals relocated to suitable habitat nearby where possible.

The proposal is unlikely to disrupt the breeding cycle of an important population of this species.

Is the action likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a vulnerable species is likely to decline?

Diuris tricolor has not been recorded within the study area. Records of this species occur approximately 130 kilometres to the south (at Muswellbrook) or 140 kilometres to the north (at Warialda) (Department of Environment and Conservation 2006a). It has also been recorded at Premer (80 kilometres to south west) and Narrabri (100 kilometres to north west) (pers comm. P. Spark).

Approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of marginal habitat would be removed or disturbed during the construction of the proposed dam upgrade for Options B1, D2 and D3 respectively. Further marginal habitat would be disturbed during operation of the dam in very large to extreme floods, however, these events have a low frequency of occurrence. The removal or disturbance of this marginal habitat is unlikely to result in the decline of the species.

Is the action likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat?

The proposal would include clearing of native vegetation, which may allow invasive species to colonise these and adjacent areas during and after construction. Mitigation measures have been provided to minimise the likelihood of weed invasion, particularly by noxious species. A weed management plan would be prepared and implemented for the construction and operational phases and would outline weed control and management measures for the project. This would include ensuring that vehicles, equipment, boots and clothing are clean of soil and seeds prior to entering or leaving a site. Following construction, disturbed areas would be revegetated with locally indigenous species and a weed control program implemented.

Through the development and implementation of a weed management plan for the project, the proposal is unlikely to result in significant invasion of weed species within the study area.

Is the action likely to interfere substantially with the recovery of a vulnerable species?

A recovery plan has not been prepared for *Diuris tricolor*. This species has not been recorded within the study area. The nearest records of this species are at Premer (80 kilometres to south west) and Narrabri (100 kilometres to north west) (pers comm. P. Spark).Due to disturbance including ongoing grazing, the site would provide only marginal habitat. In a national context, the removal or disturbance of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of marginal habitat is not considered likely to interfere substantially with the recovery of the species.

Conclusion

The proposal is unlikely to have a significant impact on *Diuris tricolor*.

Goodenia macbarronii

Goodenia macbarronii is listed as Vulnerable under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*. It has a conservation rating of 3Vi meaning that it has a geographic range of more than 100 kilometres in Australia and is a Vulnerable species at risk of long-term disappearance through continued depletion (Briggs & Leigh 1996).

It occurs south from Guyra and Inverell districts where it grows in damp sandy soils in seepages (Royal Botanic Gardens 2004). The species is usually found in shaded, seasonally damp sites in clay-loam, sandy-loam and sandy soils. Habitats in NSW include a recently graded roadside drain adjacent to *Eucalyptus crebra* and *Callitris glaucophylla* woodland, dry eucalypt forest with low shrubby undergrowth in sandy soil, damp sandy patches in bushland areas, along roadsides, near water in a shallow excavation which has exposed the clay subsoil, on the banks of a sandy creek and in *Eucalyptus blakelyi* and *Angophora floribunda* woodland. Sites often have some form of recent disturbance, such as depressions made by grading and excavation along roadsides. Other sites include grazed paddocks and clearings with a large proportion of weed and exotic species, and cleared open grazing land which was formerly eucalypt woodland (Department of Environment and Conservation 2006b).

Is the action likely to lead to a long-term decrease in the size of an important population of a species?

Under the *Environment Protection and Biodiversity Conservation Act 1999*, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity; and/or
- at or near the limit of the species range.

Goodenia macbarronii occurs from Guyra and Inverell districts to Deniliquin. It has not been recorded within the study area and the nearest records are approximately 60 kilometres to the south east (near Tamworth) or 80 kilometres to the west (in Pilliga Nature Reserve). This species is threatened by grazing and as such the majority of the study area is unlikely to support a viable population.

The study area is not at the limit of distribution of this species and if it occurs within the site, the population would be unlikely to be a key source population or be necessary for maintaining genetic diversity. The study area is therefore unlikely to be an important population. Potential habitat for this species does not occur within the development footprint and as such the proposal is unlikely to result in the long-term decrease in the size of an important population.

Is the action likely to reduce the area of occupancy of an important population?

If this species occurs within the study area, the population would be unlikely to be an important population (see above). Habitat for this species is restricted to the potential inundation areas and these areas provide only marginal habitat due to past and ongoing grazing, which is a recognised threat for this species. The disturbance of this marginal habitat is unlikely to result in the decline of the species.

Is the action likely to fragment an existing important population into two or more populations?

Habitat for this species is restricted to the potential inundation areas and these areas provide only marginal habitat due to past and ongoing grazing, which is a recognised threat for this species. The majority of the proposed works are adjacent to existing clearings and infrastructure and would not result in fragmentation of potential habitat for this species.

Is the action likely to adversely affect habitat critical to the survival of a species?

There is no critical habitat listed for this species and due to past and ongoing disturbance through grazing, the site is unlikely to be critical to the survival of this species.

Is the action likely to disrupt the breeding cycle of an important population?

If this species occurs within the study area, the population would be unlikely to be an important population. The site provides only marginal habitat for this species due to past and ongoing grazing, which is a recognised threat. The proposed development is largely within or adjacent to existing clearing and potential habitat for this species is restricted to inundation areas. The proposal is unlikely to clear or fragment of populations and is unlikely to disrupt the breeding cycle of this species.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

This species was not recorded within the site and the nearest records are approximately 60 kilometres to the south east (near Tamworth) or 80 kilometres to the west (in Pilliga Nature Reserve). Habitat for this species is restricted to the potential inundation areas and these areas provide only marginal habitat due to past and ongoing grazing, which is a recognised threat for this species. The disturbance of this marginal habitat is unlikely to result in the decline of the species.

Is the action likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

The proposal would include clearing of native vegetation, which may allow invasive species to colonise these and adjacent areas during and after construction. Mitigation measures have been provided to minimise the likelihood of weed invasion, particularly by noxious species. A weed management plan would be prepared and implemented for the construction and operational phases and would outline weed control and management measures for the project. This would include ensuring that vehicles, equipment, boots and clothing are clean of soil and seeds prior to entering or leaving a site. Following construction, disturbed areas would be revegetated with locally indigenous species and a weed control program implemented.

Through the development and implementation of a weed management plan for the project, the proposal is unlikely to result in significant invasion of weed species within the study area.

Is the action likely to interfere substantially with the recovery of the species?

The study area provides only marginal habitat for this species due to intensity of grazing. Habitat for this species is restricted to the potential inundation areas and these areas provide only marginal habitat due to past an ongoing grazing, which is a recognised threat for this species. These areas are unlikely to be disturbed and the frequency of disturbance of these areas would be decreased as a result of the proposal. As such, the proposal is unlikely to substantially interfere with the recovery of the species.

Conclusion

The proposal is unlikely to significantly impact *Goodenia macbarronii*.

Swainsona murrayana

Swainsona murrayana is listed as Vulnerable under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*. It has a conservation rating of 3Vi meaning that it has a geographic range of more than 100 kilometres in Australia, it is a Vulnerable species at risk of long-term disappearance through continued depletion and less than 1,000 plants are known to occur within a conservation reserve(s) (Briggs & Leigh 1996).

Found throughout NSW, it has been recorded in the Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree (Department of Environment and Conservation 2006b).

It grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with Maireana species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated. The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. The species may require some disturbance and has been known to occur in paddocks that have been moderately grazed or occasionally cultivated (Department of Environment and Conservation 2006b; Royal Botanic Gardens 2005).

Is the action likely to lead to a long-term decrease in the size of an important population of a species?

Under the *Environment Protection and Biodiversity Conservation Act 1999*, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity; and/or
- at or near the limit of the species range.

Swainsona murrayana occurs from Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree(Department of Environment and Conservation 2006b). It has not been recorded within the study area. The nearest records approximately 60 kilometres to the south west (near Lake Goran) and 100 kilometres to the north-west (near Narrabri) (Department of Environment and Conservation 2006b).

The study area is not at the limit of distribution of this species and if this species occurs within the study area, the population would be unlikely to be a key source population or be necessary for maintaining genetic diversity. The study area is therefore unlikely to support an important population.

No known population would be impacted and potential habitat for this species does not occur within the construction footprint.

Is the action likely to reduce the area of occupancy of an important population?

If this species occurs within the study area, the population would be unlikely to be an important population. Potential habitat for this species is restricted to the potential inundation areas and the majority of these areas provide only marginal habitat due to past and ongoing grazing, which is a recognised threat for this species.

Potential habitat would not be directly impacted by construction but flooding associated with dam failure would be likely to destroy this habitat through soil erosion and sedimentation. However, the likelihood of flooding is very low and the frequency of inundation of these areas would be decreased as a result of the proposal. The proposal is unlikely to reduce the area of occupancy of this species and potential impacts to its habitat would be lessened as a result of upgrade and decreased probability of flooding.

Is the action likely to fragment an existing important population into two or more populations?

If this species occurs within the study area, the population would be unlikely to be an important population. Potential habitat for this species is restricted to the potential inundation areas and the majority of these areas provide only marginal habitat due to past and ongoing grazing, which is a recognised threat for this species.

Potential habitat would not be directly impacted by construction but flooding associated with dam failure could impact this habitat. However, the likelihood of flooding is very low and the frequency of inundation of these areas would be decreased as a result of the proposal.

Is the action likely to adversely affect habitat critical to the survival of a species?

There is no critical habitat listed for this species. Potential habitat for this species is restricted to the potential inundation areas and the majority of these areas provide only marginal habitat due to past an ongoing grazing, which is a recognised threat for this species.

Is the action likely to disrupt the breeding cycle of an important population?

If this species occurs within the study area, the population would be unlikely to be an important population. Potential habitat would not be directly impacted by construction but flooding associated with dam failure could impact this habitat. The likelihood of flooding is very low and the frequency of inundation of these areas would be decreased as a result of the proposal.

Potential habitat for this species does not occur within the construction footprint. The proposal is unlikely to disrupt the breeding cycle of this species and potential impacts to its habitat would be lessened as a result of upgrade and decreased probability of flooding.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

This species was not recorded within the site and the nearest records are approximately 60 kilometres to the south west at Lake Goran or 100 kilometres to the north west (near Narrabri) (Department of Environment and Conservation 2006b)

Habitat for this species is restricted to the potential inundation areas and these areas provide only marginal due to past an ongoing grazing, which is a recognised threat for this species (Department of Environment and Conservation 2006b). Flooding would be likely to destroy the habitat for this species due to soil erosion and sedimentation. However, the likelihood of flooding is very low and the frequency of inundation of these areas would be decreased as a result of the proposal. The disturbance of this marginal habitat is unlikely to result in the decline of the species.

Is the action likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

Potential habitat for this species is restricted to areas which may be subject to inundation as a result of flooding in the region. These areas provide only marginal habitat due to past an ongoing grazing, which is a recognised threat for this species. The proposed construction activities would not include impacts to areas of potential habitat for this species and as such are unlikely to result in increased invasion of weed species in these areas. In the unlikely event of flooding, areas of potential habitat are likely to be significantly modified due to erosion and sedimentation and as a result are likely to also become invaded by weed species. However, these impacts would be similar to the current situation and are unlikely to increase as a result of the upgrade.

Mitigation measures have been provided to minimise the likelihood of weed invasion, particularly by noxious species. A weed management plan would be prepared and implemented for the construction and operational phases and would outline weed control and management measures for the project. This would include ensuring that vehicles, equipment, boots and clothing are clean of soil and seeds prior to entering or leaving a site. Following construction, disturbed areas would be revegetated with locally indigenous species and a weed control program implemented.

Through the development and implementation of a weed management plan for the project, the proposal is unlikely to result in significant invasion of weed species within the study area.

Is the action likely to interfere substantially with the recovery of the species?

Habitat for this species is restricted to the potential inundation areas and these areas provide only marginal due to past an ongoing grazing, which is a recognised threat for this species (Department of Environment and Conservation 2006b). These areas would not be directly impacted during construction and flooding of these areas is unlikely and the frequency of flooding of these areas would be decreased as a result of the proposal. As such, the proposal is unlikely to substantially interfere with the recovery of the species.

Conclusion

The proposal is unlikely to significantly impact *Swainsona murrayana.*

Bothriochloa biloba

Bothriochloa biloba is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. It has a conservation rating of 3V meaning that it has

a geographic range of more than 100 kilometres in Australia and is a Vulnerable species at risk of long-term disappearance through continued depletion (Briggs & Leigh 1996).

Bothriochloa biloba has a widespread distribution and grows in woodland on poorer soils (Harden 1993). It occurs on basaltic hills and grassland on drainage slopes on a variety of soils in association with *Eucalyptus punctata*, *E. albens*, *E.camaldulensis*, *E. tereticornis*, *E. populnea* ssp *bimbil* and *Angophora floribunda* (Department of Land and Water Conservation, 2001).

A single individual of *Bothriochloa biloba* was recorded previously within the study area to the south-east of the subsidiary dam wall (Hunter 2002). This individual and its habitat would be destroyed if there was a breach of the subsidiary dam wall (Option B1).

Is the action likely to lead to a long-term decrease in the size of an important population of a species?

Under the *Environment Protection and Biodiversity Conservation Act 1999*, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity; and/or
- at or near the limit of the species range.

Bothriochloa biloba is widespread and occurs from Deniliquin in the south to Warwick-Lismore region in the north, west to Cobar and east to the coast (Department of Environment and Conservation 2006b). The study area is not at the limit of distribution of this species.

Only one individual was recorded within the study area. Other records occur approximately 16 kilometres to the east and west (Department of Environment and Conservation 2006b). This individual would be unlikely to be a key source population or be necessary for maintaining genetic diversity. The study area is therefore unlikely to support an important population. However, it is also said to be common on roadsides in the locality (pers comm. P. Spark). The proposed development is unlikely to lead to a long term decrease in the size of an important population, however, as a precaution pre-clearing surveys are recommended.

Is the action likely to reduce the area of occupancy of an important population?

Only one individual was recorded within the study area. Other records occur approximately 16 kilometres to the east and west (Department of Environment and Conservation 2006b). This individual would be unlikely to be part of an important population and is not within the construction footprint. The proposal is unlikely to reduce the area of occupancy of an important population. However, since this species is said to be common on roadsides in the locality (pers comm. P. Spark) pre clearing surveys are recommended.

Is the action likely to fragment an existing important population into two or more populations?

Only one individual was recorded within the study area. This individual would be unlikely to be part of an important population and is not within the construction footprint. The proposal would not result in fragmentation of this known population.

Although the majority of the proposed works are adjacent to existing clearings and infrastructure, clearing for construction would result in fragmentation of Woodland in the right-hand abutment area and in the travelling stock reserve (for an access track). Although not recorded in these areas, this species is said to be common on roadsides in the locality (pers comm. P. Spark). As a precaution pre-clearing surveys are recommended.

Is the action likely to adversely affect habitat critical to the survival of a species?

There is no critical habitat listed for this species. Only one individual was recorded within the study area. This individual is not within the construction footprint of the proposal. However, in the case of a flood of 1:10,000 AEP or less, Option B1 would result in a breach of the subsidiary dam wall and the destruction of this individual and its habitat as a result of scouring. Other areas of potential habitat occur within White Box Yellow Box Blakely's Red Gum Woodland, Bimbil Box Woodland and Grassland. Only a small area of potential habitat would be directly impacted as a result of construction activities.

The likelihood of impacts to the known individual and its habitat is very low and this habitat is unlikely to be critical to the survival of this species.

Is the action likely to disrupt the breeding cycle of an important population?

Only one individual was recorded within the study area. Other records occur approximately 16 kilometres to the east and west (Department of Environment and Conservation 2006b). This individual would be unlikely to be part of an important population and is not within the construction footprint. The proposal is unlikely to disrupt the breeding cycle of this population. However, since this species is said to be common on roadsides in the locality (pers comm. P. Spark) pre clearing surveys are recommended and further mitigation measures may be required if species is located.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Only one individual was recorded within the study area. This individual is not within the construction footprint of the proposal. However, in the case of a flood of 1:10,000 AEP or less, Option B1 would result in a breach of the subsidiary dam wall and the destruction of this individual and its habitat as a result of scouring. Other areas of potential habitat occur within White Box Yellow Box Blakely's Red Gum Woodland, Bimbil Box Woodland and Grassland. Only a small area of potential habitat would be directly impacted as a result of construction activities.

The likelihood of impacts to the known individual and its habitat is very low (1:10,000 AEP or less) and this habitat is unlikely to be critical to the survival of this species. The proposal is unlikely to remove or destroy habitat to the extent that the species is likely to decline.

Is the action likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

In the unlikely event (1:10,000 AEP or less) of flooding, areas of potential habitat are likely to be significantly modified due to erosion and sedimentation and as a result are likely to also become invaded by weed species. However, these impacts would be similar to the current situation and are unlikely to increase as a result of the upgrade.

A small area of potential habitat within the travelling stock reserve would be cleared for an access track to construction areas. Construction in this area could result in invasion of introduced species into this area.

Mitigation measures have been provided to minimise the likelihood of weed invasion, particularly by noxious species. A weed management plan would be prepared and implemented for the construction and operational phases and would outline weed control and management measures for the project. This would include ensuring that vehicles, equipment, boots and clothing are clean of soil and seeds prior to entering or leaving a site. Following construction, disturbed areas would be revegetated with locally indigenous species and a weed control program implemented.

Through the development and implementation of a weed management plan for the project, the proposal is unlikely to result in significant invasion of weed species within the study area.

Is the action likely to interfere substantially with the recovery of the species?

Only one individual was recorded within the study area. This individual is not within the construction footprint of the proposal. However, in the case of a flood of approximately 1:10,000 AEP or less, Option B1 would result in a breach of the subsidiary dam wall and the destruction of this individual and its habitat as a result of scouring. Other areas of potential habitat occur within White Box Yellow Box Blakely’s Red Gum Woodland, Bimbil Box Woodland and Grassland. Areas of potential habitat for this species are largely restricted to areas which may be subject to inundation as a result of flooding of the region. Only a small area of potential habitat would be directly impacted as a result of construction activities.

The proposal would include clearing of a small area of potential habitat (within the travelling stock reserve). Impacts to the known individual or other areas of potential habitat are associated with inundation and scouring as a result of flooding. These impacts are unlikely (approximately 1:10,000 AEP or less) to occur.

The proposal is unlikely to substantially interfere with the recovery of the species.

Conclusion

The proposal is unlikely to significantly impact *Bothriochloa biloba*.

Digitaria porrecta

Digitaria porrecta is listed as Endangered under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*. It has a conservation rating of 3V meaning that it has a geographic range of more than 100 kilometres in Australia and is a Vulnerable species at risk of long-term disappearance through continued depletion (Briggs & Leigh 1996).

Digitaria porrecta occurs in NSW and Queensland. In NSW it is found on the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran. It grows in native grassland, woodlands or open forest with a grassy understorey, on richer soils. It is often found along roadsides and travelling stock reserves where there is light grazing and occasional fire (Department of Environment and Conservation 2006b).

This species has not been recorded within the study area, however, the study area provides potential habitat.

Is the action likely to lead to a long-term decrease in the size of a population of the species?

This species has not been recorded within the study area. The nearest record occurs approximately 40 kilometres to the south-west on the Oxley Highway near Haystack Mountain and in Travelling Stock Reserves at Werris Creek and Caroon.

The proposal would include clearing of a small area of potential habitat (within travelling stock reserve). Other areas within the construction footprint are unlikely to provide potential habitat for this species due to past disturbance.

Other areas of potential habitat occur within White Box Yellow Box Blakely's Red Gum Woodland, Bimbil Box Woodland and Grassland may be subject to inundation as a result of flooding of the region. These impacts are unlikely to occur.

The removal of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of potential habitat for construction and the unlikely flooding of other areas of potential habitat are unlikely to lead to a long-term decrease in the size of a population.

Is the action likely to reduce the area of occupancy of the species?

This species has not been recorded within the study area. The nearest record occurs approximately 40 kilometres to the south-west on the Oxley Highway near Haystack Mountain. Only a small area of potential habitat would be cleared for the proposal (within the travelling stock reserve). This clearing is unlikely to reduce the area of occupancy of the species. As a precaution, pre-clearing surveys for this species are recommended.

Other areas of potential habitat could be subject to inundation as a result of flooding of the region. However, this is an unlikely event.

The proposal is unlikely to reduce the area of occupancy of the species.

Is the action likely to fragment an existing population into two or more populations?

No known populations occur within the study area. The nearest record occurs approximately 40 kilometres to the south-west on the Oxley Highway near Haystack Mountain and in Travelling Stock Reserves at Werris Creek and Caroon.The construction activities are near the existing dam wall and caravan park and as such are largely restricted to disturbed areas adjacent to existing clearings and infrastructure. However, a small area of potential habitat within the travelling stock reserve would be cleared for an access track. If this species is present within this area, the clearing may result in fragmentation of a population. As a precaution, pre-clearing surveys for this species are recommended.

The proposal is unlikely to fragment an existing population.

Is the action likely to adversely affect habitat critical to the survival of a species?

There is no critical habitat listed for this species. Areas of potential habitat for this species are largely restricted to areas which may be subject to inundation as a result of flooding of the region. Only a small area of potential habitat would be directly impacted as a result of construction activities. This habitat is unlikely to be critical to the survival of this species.

Is the action likely to disrupt the breeding cycle of a population?

No known populations occur within the study area. The nearest record occurs approximately 40 kilometres to the south-west on the Oxley Highway near Haystack Mountain and in Travelling Stock Reserves at Werris Creek and Caroon.. A small area of potential habitat within the travelling stock reserve would be cleared for an access track. If this species is present within this are, the clearing may result in fragmentation of a population. As a precaution, pre-clearing surveys for this species are recommended.

Other areas of potential habitat are restricted to areas which may be subject to inundation as a result of flooding of the region. This is an unlikely event and as such is unlikely to disrupt the breeding cycle of a population.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

No known populations occur within the study area. The nearest record occurs approximately 40 kilometres to the south-west on the Oxley Highway near Haystack Mountain. A small area of potential habitat within the travelling stock reserve would be cleared for an access track. If this species is present within this area, the clearing may result in fragmentation of a population. As a precaution, pre-clearing surveys for this species are recommended.

Other areas of potential habitat are restricted to areas which may be subject to inundation as a result of flooding of the region. This is an unlikely event.

The clearing of a small area of potential habitat and the unlikely disturbance of potential habitat as a result of flooding is unlikely to result in the decline of the species.

Is the action likely to result in invasive species that are harmful to an endangered species becoming established in the endangered species habitat?

Potential habitat for this species is largely restricted to areas which may be subject to inundation as a result of flooding in the region. In the unlikely event of flooding, areas of potential habitat are likely to be significantly modified due to erosion and sedimentation and as a result are likely to also become invaded by weed species. However, these impacts would be similar to the current situation and are unlikely to increase as a result of the upgrade.

A small area of potential habitat within the travelling stock reserve would be cleared for an access track to construction areas. Construction in this area could result in invasion of introduced species into this area.

Mitigation measures have been provided to minimise the likelihood of weed invasion, particularly by noxious species. A weed management plan would be prepared and implemented for the construction and operational phases and would outline weed control and management measures for the project. This would include ensuring that vehicles, equipment, boots and clothing are clean of soil and seeds prior to entering or leaving a site. Following construction, disturbed areas would be revegetated with locally indigenous species and a weed control program implemented.

Through the development and implementation of a weed management plan for the project, the proposal is unlikely to result in significant invasion of weed species within the study area.

Is the action likely to interfere with the recovery of the species?

No known populations occur within the study area with the nearest record occurs approximately 40 kilometres to the south-west and is also known to occur at Werris Creek (pers. comm. P. Sparkes). The clearing of a small area of potential habitat and the unlikely disturbance of potential habitat as a result of flooding is unlikely to interfere with the recovery of the species.

Conclusion

The proposal is unlikely to significantly impact *Digitaria porrecta*.

Dichanthium setosum

Dichanthium setosum is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*.

Dichanthium setosum occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, as well as in Queensland and Western Australia. It occurs widely on private property, including in the Inverell, Guyra, Armidale and Glen Innes areas (Department of Environment and Conservation 2006c). It grows in woodland and grassland (Harden 1993). On the New England Tablelands and North West Slopes it grows on stony red-brown hard-setting soils over basalt, or on black soil (Department of Environment and Conservation 2006c).

This species has not been recorded within the site. The nearest record for this species is near Tamworth, approximately 50 kilometres to the south east (Department of Environment and Conservation 2006a).

Is the action likely to lead to a long-term decrease in the size of an important population of a species?

Under the *Environment Protection and Biodiversity Conservation Act 1999*, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity; and/or
- at or near the limit of the species range.

Dichanthium setosum has not been recorded within the site or nearby areas. It occurs widely on private property, including in the Inverell, Guyra, Armidale and Glen Innes areas (Department of Environment and Conservation 2006b), but has not been recorded within the vicinity of the site with the nearest record approximately 50 kilometres to the south east, near Tamworth (Department of Environment and Conservation 2006a). The site is unlikely to be a key source population for breeding or dispersal or be necessary for maintaining genetic diversity.

It occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, as well as in Queensland and Western Australia (Department of Environment and Conservation 2006c). The study area is not at the limit of distribution of this species.

The study area is unlikely to support an important population and as such the proposed development is unlikely to lead to a long term decrease in the size of an important population. However, the site contains potential habitat for this species and since it generally flowers in summer, surveys for the proposed development are unlikely to have recorded this species if present within the site. As a precaution pre-clearing surveys during its flowering period (summer) are recommended.

Is the action likely to reduce the area of occupancy of an important population?

The study area is unlikely to support an important population and as such the proposed development is unlikely to lead to a long term decrease in the size of an important population (see above). However, the site contains potential habitat for this species and would include the clearing of up to 49.8 hectares. Since this species generally flowers in summer, surveys for the proposed development are unlikely to have recorded it even if present within the site. As a precaution pre-clearing surveys during its flowering period (summer) are recommended.

Is the action likely to fragment an existing important population into two or more populations?

Dichanthium setosum has not been recorded within the site or nearby areas. The nearest record approximately 50 kilometres to the south east, near Tamworth (Department of Environment and Conservation 2006a). The proposal would not result in fragmentation of known populations.

Although the majority of the proposed works are adjacent to existing clearings and infrastructure, clearing for construction would result in fragmentation of Woodland in the right-hand abutment area and in the travelling stock reserve (for an access track). Although not recorded in these areas, the site contains potential habitat for this species. As a precaution pre-clearing surveys are recommended.

Is the action likely to adversely affect habitat critical to the survival of a species?

There is no critical habitat listed for this species. *Dichanthium setosum* has not been recorded within the site or nearby areas. The nearest record approximately 50 kilometres to the south east, near Tamworth (Department of Environment and Conservation 2006a) and is known to occur widely in the Inverell, Guyra, Armidale and Glen Innes areas (Department of Environment and Conservation 2006c). The site unlikely to be critical to the survival of this species.

Is the action likely to disrupt the breeding cycle of an important population?

The study area is unlikely to support an important population (see above) and as such the proposed development is unlikely to disrupt the breeding cycle of an important population. However, the site contains potential habitat for this species and would include the clearing of up to 49.8 hectares. Since this species generally flowers in summer, surveys for the proposed development are unlikely to have recorded it even if present within the site. As a precaution pre-clearing surveys during its flowering period (summer) are recommended.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Dichanthium setosum has not been recorded within the site or nearby areas. The nearest record approximately 50 kilometres to the south east, near Tamworth (Department of Environment and Conservation 2006a) and is known to occur widely in the Inverell, Guyra, Armidale and Glen Innes areas. This species is unlikely to occur, however, the site contains potential habitat for this species and would include the clearing of up to 49.8 hectares. Since this species generally flowers in summer, surveys for the proposed development are unlikely to have recorded it even if present within the site. As a precaution pre-clearing surveys during its flowering period (summer) are recommended.

Is the action likely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

In the unlikely event (1:10,000 AEP or less) of flooding, areas of potential habitat are likely to be significantly modified due to erosion and sedimentation and as a result are likely to also become invaded by weed species. However, these impacts would be similar to the current situation and are unlikely to increase as a result of the upgrade.

A small area of potential habitat within the travelling stock reserve would be cleared for an access track to construction areas. Construction in this area could result in invasion of introduced species into this area.

Mitigation measures have been provided to minimise the likelihood of weed invasion, particularly by noxious species. A weed management plan would be prepared and implemented for the construction and operational phases and would outline weed control and management measures for the project. This would include ensuring that vehicles, equipment, boots and clothing are clean of soil and seeds prior to entering or leaving a site. Following construction, disturbed areas would be revegetated with locally indigenous species and a weed control program implemented.

Through the development and implementation of a weed management plan for the project, the proposal is unlikely to result in significant invasion of weed species within the study area.

Is the action likely to interfere substantially with the recovery of the species?

Dichanthium setosum has not been recorded within the site or nearby areas. The nearest record approximately 50 kilometres to the south east, near Tamworth (Department of Environment and Conservation 2006a) and is known to occur widely in the Inverell, Guyra, Armidale and Glen Innes areas (Department of Environment and Conservation 2006c). The site unlikely to be critical to the survival of this species.

The proposal is unlikely to result in fragmentation or significant increases in weed invasion in areas of potential habitat. The proposal is unlikely to interfere substantially with the recovery of the species. However, the site contains potential habitat for this species and since it generally flowers in summer, surveys for the proposed development are unlikely to have recorded this species if present within the site. As a precaution pre-clearing surveys during its flowering period (summer) are recommended.

Conclusion

The proposal is unlikely to significantly impact *Dichanthium setosum*.

Hakea pulvinifera

Hakea pulvinifera is listed as Endangered under both the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*. It has a conservation rating of 2Ei meaning that:

- it is a species with a geographic range of less than 100 kilometres in Australia
- it is an Endangered species that is at risk of disappearing from the wild if present land use and other causal factors continue to operate
- less than 1,000 plants are known to occur within a conservation reserve(s) (Briggs & Leigh 1996).

Hakea pulvinifera is known from a single population near the Namoi River below Keepit Dam where it grows on a hard rocky hillside (Department of Environment and Conservation 2006b). The population grows within *Callitris glaucophylla* open woodland with a groundcover of *Cymbopogon obtectus* and *Themeda australis*. There are less than 150 individuals with two age classes evident. The older class is senescent and is in decline. The plants are between 310 and 350 metres altitude above sea level.

Flood modelling estimates that approximately 68% of the *Hakea pulvinifera* population would currently be destroyed by inundation and high velocity flows in a probable maximum flood in which the main dam wall fails. The modelling estimates that the proposal would result in reduced impact to the population by avoiding main dam wall failure and controlling the release of floodwaters to the Namoi River. It is estimated that Options B1, D2 and D3 would result in destruction of 31%, 56% and 54% of the population respectively in a probable maximum flood.

Is the action likely to lead to a long-term decrease in the size of a population of the species?

Hakea pulvinifera is known from a single population below Keepit Dam. The proposed construction works would not impact this population or its habitat. However, operation of the existing main dam wall spillway and the proposed right-hand abutment spillway in large floods would result in inundation of part of the population. The maximum inundation would occur in a probable maximum flood and would result in flooding of an estimated 31%, 56% and 54% of this population for Options B1, D2 and D3 respectively with flood velocities estimated at between 3.1 metres per second for Option B1 and 3.6 metres per second for Options D2 and D3. By comparison, for the existing dam, a probable maximum flood would result in dam failure and inundation of an estimated 65% of the population and floodwaters velocity of 8.1 metres per second.

Although the proposal could result in the long-term decrease in the size of the population this occurrence is likely to be less severe with a smaller impact on this population.

Is the action likely to reduce the area of occupancy of the species?

The proposal would not clear any individuals or their habitat. However, operation of the existing main dam wall spillway and the proposed right-hand abutment spillway in large floods would result in inundation of part of the population. The maximum inundation would occur in a probable maximum flood and would result in flooding of an estimated 31%, 56% and 54% of this population for Options B1, D2 and D3 respectively with flood

velocities estimated at between 3.1 metres per second for Option B1 and 3.6 metres per second for Options D2 and D3. By comparison, for the existing dam, a probable maximum flood would result in dam failure and inundation of an estimated 65% of the population and floodwaters velocity of 8.1 metres per second.

Although the proposal could result in the long-term decrease in the size of the population this occurrence is likely to be less severe with a smaller impact on this population.

Is the action likely to fragment an existing population into two or more populations?

The proposal would not clear any individuals or their habitat. However, operation of the existing main dam wall spillway and the proposed right-hand abutment spillway in large floods would result in inundation of part of the population. This would result in individuals closer to the river (at lower altitudes) being destroyed and is unlikely to result in fragmentation of the population.

Is the action likely to adversely affect habitat critical to the survival of a species?

There is no critical habitat listed for this species, however, given that this species is only known from one location, this area should be considered as critical. The proposal would not clear any habitat. However, operation of the existing main dam wall spillway and the proposed right-hand abutment spillway in large floods would result in inundation of part of the population.

Although the proposal could result in the loss of habitat critical to the survival of the population this occurrence is likely to be less severe with a smaller impact on this population and its habitat.

Is the action likely to disrupt the breeding cycle of a population?

The proposal would not clear any habitat. However, operation of the existing main dam wall spillway and the proposed right-hand abutment spillway in large floods would result in inundation of part of the population. This species is thought to be clonal and therefore the removal of part of the population is unlikely to disrupt the breeding cycle of this species. Furthermore, the proposal is predicted to decrease the likelihood and severity of the impact compared to current conditions.

Is the action likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The proposal would not clear any individuals or their habitat. However, operation of the existing main dam wall spillway and the proposed right-hand abutment spillway in large floods would result in inundation of part of the population. Due to its small size, the eventual loss of this population is likely to be inevitable (NSW National Parks and Wildlife Service 2000). The proposal is likely to decrease the probability of this loss during large floods by decreasing the likelihood and severity of the flood compared to current conditions.

Is the action likely to result in invasive species that are harmful to an endangered species becoming established in the endangered species habitat?

During operation of the existing main dam wall spillway and the proposed right-hand abutment spillway in large floods, areas of potential habitat are likely to be significantly

modified due to erosion and sedimentation and as a result are likely to also become invaded by weed species. However, these impacts would be similar to the current situation and are unlikely to increase as a result of the proposal.

Mitigation measures have been provided to minimise the likelihood of weed invasion, particularly by noxious species. A weed management plan would be prepared and implemented for the construction and operational phases and would outline weed control and management measures for the project. This would include preventing access of workers or equipment to the population or nearby areas; ensuring that vehicles, equipment, boots and clothing are clean of soil and seeds prior to entering or leaving a site. Following construction, disturbed areas would be revegetated with locally indigenous species and a weed control program implemented.

Through the development and implementation of a weed management plan for the project, the proposal is unlikely to result in significant invasion of weed species within the study area.

Is the action likely to interfere with the recovery of the species?

The recovery plan for this species states that the population is considered likely to survive in the short to medium term (next 50 years) but given its restricted size and location, the eventual loss of this population may be inevitable (NSW National Parks and Wildlife Service 2000).

The aim for recovery of this species is to protect the population from factors that may result in accelerated or 'unnatural' decline (NSW National Parks and Wildlife Service 2000). Given that flooding is a natural event, and the proposal would decrease the level and velocity of floodwaters, the action is unlikely to interfere with this aim or the recovery of the species.

Conclusion

The proposal would not directly impact this population or result in an increase in likely impacts during a flood event. The proposal is unlikely to significantly interfere with the recovery of the species.

Threatened Woodland Birds

Threatened woodland birds have been assessed together as they generally share similar habitat requirements; threats that affect their recovery; and, potential impacts as result of the Proposal. Woodland species of bird considered under the Heads of Consideration for the current Proposal include:

- Brown Treecreeper (*Climacteris picumnus victoriae*)
- Hooded Robin (*Melanodryas cucullata cucullate*)
- Black-chinned Honeyeater (*Melithreptus gularis gularis*)
- Painted Honeyeater (*Grantiella picta*)
- Grey-crowned Babbler (*Pomatostomus temporalis*)
- Speckled Warbler (*Pyrrholaemus sagittatus*)
- Diamond Firetail (*Stagonopleura guttata*)

All seven species are part of a groups of woodland birds considered to be declining within Australia (Reid 1999; Trail & Duncan 2000) and are listed as Vulnerable under the *Threatened Species Conservation Act 1995*.

Threats that affect these species include: clearing of woodland resulting in loss and fragmentation of habitat; modification and destruction of ground habitat through heavy grazing and compaction by stock, removal of litter and fallen timber, introduction of exotic pasture grasses and frequent fire (Department of Environment and Conservation 2006b; Reid 1999; Trail & Duncan 2000).

Brown Treecreeper (eastern subspecies) - *Climacteris picumnus victoriae*

Brown Treecreepers occur in eucalypt woodland and adjoining vegetation. Sometimes this species is recorded in semi-cleared pasture; in grasslands scattered with trees in cleared paddocks outside woodlands or in shelterbelts fringing cleared lands (Higgins et al. 2001). It is sedentary and nests in tree hollows (Garnett & Crowley 2000) breeding in pairs or communally in small groups within territories ranging in size up to 11 hectares. The nest is a collection of grasses, feathers and other soft material, placed in a suitable tree hollow or similar site (Higgins et al. 2001). Birds forage on tree trunks and on the ground amongst leaf litter and on fallen logs for ants, beetles and larvae (Pizzey & Knight 1997).

Hooded Robin (south-eastern form) - *Melanodryas cucullata cucullata*

Hooded Robins occur in lightly wooded country, usually open eucalypt woodland, mallee and acacia shrublands. Movements are not well known, however, they are thought to be resident or sedentary, but may undertake some local movements (Department of Environment and Conservation 2006b), possibly in response to drought and food availability (Pizzey & Knight 1997). Territories range from around 10 hectares during the breeding season, to 30 hectares in the non-breeding season. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1 metre to 5 metres above the ground (Higgins & Peter 2002).

This species was not recorded during surveys.

Black-chinned Honeyeater (eastern subspecies) - *Melithreptus gularis gularis*

This species occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. Its also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees (Department of Environment and Conservation 2006b). It is a gregarious species usually seen in pairs and small groups of up to 12 birds (Higgins & Davies 1996). Feeding territories are large, making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least five hectares. Nectar is taken from flowers, and honeydew is gleaned from foliage (Higgins & Davies 1996).

This species was not recorded during surveys.

Painted Honeyeater- *Grantiella picta*

Painted Honeyeaters occur in dry forests and woodlands. The primary food is mistletoes in the genus *Amyema*, although they will take some nectar and insects (Department of Environment and Conservation 2006b). The breeding distribution is dictated by the presence of mistletoes, which are largely restricted to older trees. The species is less likely to be found in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett & Crowley 2000).

This species was not recorded during surveys.

Grey-crowned Babbler – *Pomatostomus temporalis*

The Grey-crowned Babbler is found mainly in rural districts where it predominantly lives in roadsides and private land (Schulz 1991). Suitable habitats are usually abundant with leaf-litter and debris; often dominated by eucalypts including box and ironbark species, partly-cleared woodland, acacia shrubland and adjoining farmland (Higgins 1999). Grey-crowned Babblers are unlikely to occur in regrowth forest, large patches of forest or woodland and forest with dense understorey or grassland with few trees (Schulz 1991).

An understorey of young trees and shrubs, in the 10 to 25 centimetres diameter at breast height range, is used for nest sites and shelter, and a relatively sparse ground layer with more litter and less ground cover is preferred by the species (Adam & Robinson 1996). Within that broad habitat category, they prefer sites with large trees, a scattered understorey of small trees or shrubs and a sparse ground layer of litter and short grass (Davidson & Robinson 1992). At the local scale, the species is common in edge habitats where there is access to both tree-cover and open ground. Historically this edge habitat would be found near larger trees in mature woodland habitat, but is now largely restricted to roadside vegetation and the edges of remnant patches (Robinson et al. 2001). The Grey-crowned Babbler is a prolific nest builder, building nests throughout the year for both breeding and roosting (Counsilman 1979).

This species was not recorded during surveys.

Speckled Warbler- *Pyrrholaemus sagittatus*

Speckled Warblers prefers eucalypt dominated vegetation that has a grassy understorey, often on rocky ridges or in gullies (NSW Scientific Committee 2001). The bird is a

sedentary species that breeds in pairs and trios, and feeds on seeds and insects on the ground and in understorey vegetation and builds domed nests on the ground in grass tussocks, dense leaf litter and fallen branches (Reid 1999). Speckled Warblers occur at low densities (0.19 - 0.54 per hectare) and have relatively large homes of 6-12 hectares for pairs or trios of birds (Higgins & Peter 2002).

This species was recorded during surveys approximately 1 kilometre south of the caravan park in Box Gum Woodland.

Diamond Firetail - *Stagonopleura guttata*

Diamond Firetails are found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Woodlands. They occur also in open forest, mallee, native grasslands, and in secondary grasslands derived from other communities (Trail & Duncan 2000). They feed exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). They are usually encountered in flocks of between 5 to 40 birds, with groups separating into small colonies to breed, between August and January (Department of Environment and Conservation 2006b). Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. The species appears to be sedentary, although some populations move locally (Higgins & Peter 2002).

This species was not recorded during surveys.

Consideration of Impacts to Threatened Woodland Birds

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This vegetation within the footprint is generally disturbed and in poor condition. However, vegetation within the travelling stock reserve is in good condition and vegetation at the right-hand abutment although dominated by Callitris is in moderate condition.

The removal of this vegetation will remove both foraging and nesting resources for woodland species of bird. However, this amount of clearing is small in relation to the amount of similar habitat available in the wider region. Within the mapped extent of vegetation, coving a total area of 2,955 hectares, this clearing represents approximately 1.9% of the box gum woodland. While there may be some localised loss of breeding opportunities due to construction activities, large areas containing suitable nesting resources occur in areas adjacent to the construction zone.

A number of studies have suggested that the cover of vegetation within the landscape is an important predictor of the viability of population of woodland birds, with key thresholds being set. One study has suggested that threatened species of woodland bird diversity will decline at vegetation cover levels less than 30% (Reid 2000), while another has suggested a critical decline at vegetation cover levels less than 10% (Bennett & Radford 2004). Within the area of vegetation mapping (2,955 hectares centres on the dam), vegetation cover is at 42% (1,269 hectares). With the removal of up to 49.8 hectares of vegetation cover, the overall degree of vegetation cover will decline slightly to 41%. Suggesting that viable populations of threatened woodland birds can still be maintained in this area.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This vegetation within the footprint is generally disturbed and in poor condition. However, vegetation within the travelling stock reserve is in good condition and vegetation at the right-hand abutment although dominated by Callitris is in moderate condition.

The habitat to be removed would include specific habitat features such as mature trees with Mistletoe used for foraging by Painted Honeyeaters and down timber for Speckled Warblers.

Currently vegetation within the extent of vegetation mapping comprises over 42% cover, which is well above a recognised threshold (30%) below which Threatened species of woodland bird may decline (Reid 2000). With the Proposal, the extent of cover would decline to 41%. This means that there will be a modification of habitat at the local scale of the extent of clearing, but in the wider local area the habitat will remain suitable for these species.

Although operational impacts including erosion, sedimentation and destruction of habitat resulting from flooding may impact these species, the probability of flooding is very low. Further, as a result of the upgrade, this flood occurrence is less likely to occur and is also likely to be less severe that the current situation.

How is the proposal likely to affect current disturbance regimes?

The proposal would include clearing of native vegetation, which may allow invasive species to colonise these and adjacent areas during and after construction. Mitigation measures have been provided to minimise the likelihood of weed invasion, particularly by noxious species. A weed management plan would be prepared and implemented for the construction and operational phases and would outline weed control and management measures for the project. This would include ensuring that vehicles, equipment, boots and clothing are clean of soil and seeds prior to entering or leaving a site. Following construction, disturbed areas would be revegetated with locally indigenous species and a weed control program implemented.

Although operational impacts including erosion, sedimentation and destruction of habitat resulting from flooding may impact these species, the probability of flooding is very low. Further, as a result of the upgrade, this flood occurrence is less likely to occur and is also likely to be less severe that the current situation.

How is the proposal likely to affect habitat connectivity?

Within the study area woodland vegetation occurs as isolated remnants. However, even isolated trees can provide important links for fauna (NSW National Parks and Wildlife Service 2002a; NSW Scientific Committee 2002).

Although the majority of the proposed works are adjacent to existing clearings and infrastructure, clearing for construction would result in fragmentation of Woodland in the right-hand abutment area and in the travelling stock reserve (for an access track).

Due to the relatively large home range and mobility of each species, this loss of vegetation is unlikely to result in isolation of habitat for the seven species of bird. The ability to access adjacent habitats to the proposal will remain. Therefore, it is unlikely that local populations of these species would become fragmented or isolated from other areas of habitat as a result of the construction and operation of the proposal.

How is the proposal likely to affect critical habitat?

The Department of Environment and Conservation maintains a register of critical habitat. The land within the study area is not listed as a critical habitat and it is not considered critical to the survival of the seven woodland species of bird.

Conclusion

The Proposal would remove up to 18 hectares of habitat for woodland birds. This clearing will also reduce the extent of cover within the wider landscape, but not to an extent that population become unviable. With suitable mitigation measures it is unlikely that there would be a significant impact on these species.

Regent Honeyeater

The Regent Honeyeater is listed as Endangered under both the *Environment Protection and Biodiversity Conservation Act 1999* and the *Threatened Species Conservation Act 1999* as well as Migratory under the *Environment Protection and Biodiversity Conservation Act 1999*.

Under the *Environment Protection and Biodiversity Conservation Act 1999* important habitat for migratory species includes areas where the species is declining. Given that the species is endangered, it can be considered to be declining within the study area and the wider locality. This species is therefore assessed using the threatened species criteria of the *Principal Significance Guidelines 1.1* (Department of the Environment and Heritage 2006).

Regent Honeyeaters inhabit dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak (Department of Environment and Conservation 2006b). The woodlands they inhabit support a significantly high abundance and species richness of bird and have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes (Higgins et al. 2001).

Regent Honeyeaters have been recorded approximately 25 kilometres away to the north of Manilla (recorded in 1999) and approximately 20 kilometres to the west in Kelvin State Forest (recorded in 1999) (Department of Environment and Conservation 2006a).

The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Nectar and fruit from the mistletoes *Amyema miquelii, A. pendula* and *A. cambagei* are also eaten during the breeding season (Oliver 2000). When nectar is scarce, lerps and honeydew comprise a large proportion of the diet. Insects make up about 15% of the total diet and are important components of the diet of nestlings (Higgins et al. 2001). A shrubby understorey is an important source of insects and nesting material (Oliver et al. 1998).

Colour-banding of Regent Honeyeater has shown that the species can undertake large-scale nomadic movements in the order of hundreds of kilometres (Higgins et al. 2001). However, the exact nature of these movements is still poorly understood. It is likely that movements are dependent on spatial and temporal flowering and other resource patterns. To successfully manage the recovery of this species a full understanding of the habitats used in the non-breeding season is critical (Department of Environment and Conservation 2006b).

There are three known key breeding areas, two of them in NSW - Capertee Valley and Bundarra-Barraba regions (Geering & French 1998). The Bundarra-Barraba region is approximately 50 kilometres north of Lake Keepit. The species breeds between July and January in Box-Ironbark and other temperate woodlands and riparian gallery forest dominated by River She-oak. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and She-oaks (Oliver 2000). An open cup-shaped nest is constructed of bark, grass, twigs and wool (Oliver et al. 1998).

Threats to this species include:

- historical loss, fragmentation and degradation of habitat from clearing for agricultural and residential development, particularly fertile Yellow Box-White Box-Blakely's Red Gum woodlands
- continuing loss of key habitat tree species and remnant woodlands from strategic agricultural developments, timber gathering and residential developments
- suppression of natural regeneration of overstorey tree species and shrub species from overgrazing. Riparian gallery forests have been particularly impacted by overgrazing
- inappropriate forestry management practices that remove large mature resource-abundant trees. Firewood harvesting in Box-Ironbark woodlands can also remove important habitat components
- competition from larger aggressive honeyeaters, particularly Noisy Miners, Noisy Friarbirds and Red Wattlebirds
- egg and nest predation by native birds (Department of Environment and Conservation 2006b).

This species was not recorded during the current survey, but is considered likely to occur based on the suitability of habitat.

Will the action lead to a long-term decrease in the size of a population of a species?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This vegetation within the footprint is generally disturbed and in poor condition. However, vegetation within the travelling stock reserve is in good condition and vegetation at the right-hand abutment although dominated by Callitris is in moderate condition.

The removal of this vegetation will remove foraging resources for Regent Honeyeaters. However, this amount of clearing is small in relation to the amount of similar habitat available in the wider region. Within the mapped extent of vegetation, coving a total area of 2,955 hectares, this clearing represents approximately 1.9% of the box gum woodland.

The areas proposed for vegetation removal is not considered to be a significant amount in relation to the amount of similar habitat that will remain unaffected in the wider local area. This species is highly mobile and similar foraging and roosting habitat can be accessed in the local area. Although the proposal may temporarily affect the dynamics of the local population, the proposal is unlikely resulting in a decline of the local population.

Will the action reduce the area of occupancy of the species?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This amount of clearing is small in relation to the amount of similar habitat available in the wider region. Within the mapped extent of vegetation, coving a total area of 2,955 hectares, this clearing represents approximately 1.9% of the box gum woodland.

A local population of Regent Honeyeater would not be restricted to habitat resources in the study area. This species is highly mobile and has a large foraging range that would allow it to use similar habitat resources in the study area and locality.

The action would not reduce the area of occupancy for Regent Honeyeater.

Will the action fragment an existing population into two or more populations?

Regent Honeyeaters are highly mobile and have a large foraging range that allows them to use similar habitat resources in the study area and locality. Therefore, it is highly unlikely that the action would isolate habitat and fragment an existing population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

It is unlikely that there is an established breeding population of Regent Honeyeater within the study area. Any unidentified populations of Regent Honeyeater that forage in the area would not be restricted to the habitat within the site, due to the large home range.

Although operational impacts including erosion, sedimentation and destruction of habitat resulting from flooding may impact this species, the probability of flooding is very low. Further, as a result of the upgrade, this flood occurrence is less likely to occur and is also likely to be less severe that the current situation.

Therefore, the habitat in the study area is not considered critical to the survival of the species.

Will the action disrupt the breeding cycle of a population?

The Proposal will remove approximately 18 hectares of habitat for this species including foraging and potential nesting resources. It is unlikely, however, that an established breeding population of Regent Honeyeater is present in the study area given the generally disturbed nature of most of the vegetation.

It is therefore unlikely that the action would disrupt the breeding cycle of a local population of Regent Honeyeater.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The study area contains foraging resources for Regent Honeyeater that range in conditions from poor to moderate. The action is unlikely to significantly decrease the availability of foraging habitat in the study area and locality. The large home range of the species allows offsite foraging resources to be accessed and isolation of habitat would not result from the action

It is unlikely that the action would isolate and decrease the availability of quality habitat to the extent that the species is likely to decline.

Will the action result in invasive species that are harmful to an endangered species becoming established in the endangered species´ habitat?

It is highly unlikely that invasive species (such as introduced predators) that are harmful to the Regent Honeyeater would become further established as a result of the action.

Will the action introduce disease that may cause the species to decline?

There are no known significant diseases in Regent Honeyeaters causing their decline. It is highly unlikely that disease would be increased by the action.

Will the action interfere with the recovery of the species?

The Action Plan for Australian Birds (Garnett & Crowley 2000) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific breeding requirements.

Specific objectives of the Regent Honeyeater recovery (Menkhorst et al. 1999) include:

- maintain and enhance the value of Regent Honeyeater habitat at the key sites and throughout the former range, by active participation in land-use planning processes and by active vegetation rehabilitation at strategic sites
- monitor trends in the Regent Honeyeater population size and dispersion across its range to allow assessment of the efficacy of management actions
- facilitate research on strategic questions which will enhance the capacity to achieve the long-term objectives. In particular, determine the whereabouts of Regent Honeyeaters during the non-breeding season and during breeding season absences from known sites. Identify important sites and habitat requirements at these times
- maintain and increase community awareness, understanding and involvement in the recovery effort
- maintain the captive population of Regent Honeyeaters at a size which will provide adequate stock to: provide insurance against the demise of the wild population; continuously improve captive-breeding and husbandry techniques; provide adequate stock for trials of release strategies; and maintain 90% of the wild heterozygosity in the captive population.

Based on the potential ecological impacts of the Proposal on the species as discussed above, it is unlikely that the action would interfere with the recovery of this species.

Conclusion

The Regent Honeyeater is unlikely to be significantly affected by the proposal.

Swift Parrot- *Lathamus discolour*

The Swift Parrot is listed as Endangered under both the *Environment Protection and Biodiversity Conservation Act 1999* and the *Threatened Species Conservation Act 1999* and Migratory under the *Environment Protection and Biodiversity Conservation Act 1999*.

Under the *Environment Protection and Biodiversity Conservation Act 1999* important habitat for migratory species includes areas where the species is declining. Given that the species is endangered, it can be considered to be declining within the study area and the wider locality. This species is therefore assessed using the threatened species criteria of the *Principal Significance Guidelines 1.1* (Department of the Environment and Heritage 2006).

Swift Parrots migrate to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp infestations (Department of Environment and Conservation 2006b). Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens* (Higgins 1999). The parrots return to home foraging sites on a cyclic basis depending on food availability (Department of Environment and Conservation 2006b). Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum *E. globulus* (Webster 1988).

Threats

- On the mainland the main threat is loss of habitat through clearing for agriculture, and urban and industrial development.
- Collisions with wire netting fences, windows and cars, during the breeding season and winter migration - especially where such obstacles are in close proximity to suitable habitat (Department of Environment and Conservation 2006b).

This species was not recorded on site and no records exist within 10 kilometres of the site, but it may occur based on the suitability of habitat. The nearest records are approximately 40 kilometres to the west at Boggabri and approximately 40 kilometres north-east of the site.

Will the action lead to a long-term decrease in the size of a population of a species?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This vegetation within the footprint is generally disturbed and in poor condition. However, vegetation within the travelling stock reserve is in good condition and vegetation at the right-hand abutment although dominated by Callitris is in moderate condition.

The removal of this vegetation will remove foraging resources for Swift parrots. However, this amount of clearing is small in relation to the amount of similar habitat available in the wider region. Within the mapped extent of vegetation, coving a total area of 2,955 hectares, this clearing represents approximately 1.9% of the box gum woodland.

The areas proposed for vegetation removal is not considered to be a significant amount in relation to the amount of similar habitat that will remain unaffected in the wider local area. This species is highly mobile and similar foraging and roosting habitat can be accessed in the local area. Although the proposal may temporarily affect the dynamics of the local population, the proposal is unlikely resulting in a decline of the local population.

Will the action reduce the area of occupancy of the species?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This amount of clearing is small in relation to the amount of similar habitat available in the wider region. Within the mapped extent of vegetation, coving a total area of 2,955 hectares, this clearing represents approximately 1.9% of the box gum woodland.

A local population of Swift Parrots would not be restricted to habitat resources in the study area. This species is highly mobile and has a large foraging range that would allow it to use similar habitat resources in the study area and locality.

The action would not reduce the area of occupancy for Swift Parrots.

Will the action fragment an existing population into two or more populations?

Swift Parrots are highly mobile and have a large foraging range that would allow them to use similar habitat resources in the wider study area and locality. Therefore, it is highly unlikely that the action would isolate habitat and fragment an existing population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat is listed for this species under the *Environment Protection and Biodiversity Conservation Act 1999* or the *Threatened Species Conservation Act 1995*.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The Proposal will remove approximately 18 hectares of habitat for this species including foraging resources, which would not meet these criteria in that similar resources are available in the wider local and regional areas.

Therefore, habitat in the study area is not considered habitat critical to the survival of the species.

Will the action disrupt the breeding cycle of a population?

Breeding in this species occurs in Tasmania. It is therefore unlikely that the Proposal would disrupt the breeding cycle.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The study area contains foraging resources for Swift Parrot that range in condition from poor to moderate. The Proposal will remove approximately 18 hectares of habitat for this species including foraging areas. This habitat occurs as highly fragmented remnants and occurs mainly in the existing road reserve. It is unlikely that the Proposal would further isolate or decrease the availability of this habitat so that the species declines.

Will the action result in invasive species that are harmful to an endangered species becoming established in the endangered species´ habitat?

It is unlikely that further invasive species (such as introduced predators) that are harmful to the Swift Parrot would become further established as a result of the action.

Will the action introduce disease that may cause the species to decline?

No. It is unlikely that disease such as infection by Psittacine circoviral (beak and feather) disease would be increased by the action.

Will the action interfere with the recovery of the species?

The Action Plan for Australian Birds (Garnett & Crowley 2000) addresses the need for further ecological research on the species, the conservation and protection of roosting habitat, and identification of specific breeding requirements.

Specific objectives of the Swift Parrot Recovery Plan (Swift Parrot Recovery Team 2001) include:

- identify priority habitats and sites across the range of the swift parrot
- implement management strategies to protect and improve priority habitats and sites resulting in a sustained improvement in carrying capacity
- reduce the incidence of collisions with man-made structures
- determine population trends within the breeding range
- quantify improvements in carrying capacity by monitoring changes in extent and quality of habitat

- increase public awareness about the recovery program and to involve the community in the recovery.

Based on the potential ecological impacts of the Proposal on the species as discussed above, it is unlikely that the action would interfere with the recovery of this species.

Conclusion

The Swift Parrot is unlikely to be significantly affected by the Proposal.

Turquoise Parrot - *Neophema pulchella*

The Turquoise Parrot is listed as Vulnerable under Schedule 2 of the *Threatened Species Conservation Act*. This species was not recorded during field surveys, although suitable habitat exists in box gum woodlands. Turquoise Parrots have been recorded at a number of locations within the project locality as recently as 2005. Records do exist at Lake Keepit, but the species was not recorded during current surveys.

Turquoise Parrots occur in the foothills of the Great Dividing Range in eucalypt woodlands and forests with a grassy or sparsely shrubby understorey, often in the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland (Department of Environment and Conservation 2006b). They nests in hollows in trees, stumps or even fence posts, from August to December, laying four or five eggs on a nest of decayed wood dust. This species is usually seen in pairs or small, possibly family, groups and has also been reported in flocks of up to thirty individuals (Higgins 1999). The parrots spend most of the day on the ground and feed on seeds of both native and introduced grass and herb species. They forage quietly and may be quite tolerant of disturbance (Garnett & Crowley 2000).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This vegetation within the footprint is generally disturbed and in poor condition. However, vegetation within the travelling stock reserve is in good condition and vegetation at the right-hand abutment although dominated by Callitris is in moderate condition.

The removal of this vegetation will remove both foraging and nesting resources for Turquoise Parrots. However, this amount of clearing is small in relation to the amount of similar habitat available in the wider region. Within the mapped extent of vegetation, coving a total area of 2,955 hectares, this clearing represents approximately 1.9% of the box gum woodland. While there may be some localised loss of breeding opportunities due to construction activities, large areas containing suitable nesting resources occur in areas adjacent to the construction zone.

With the implementation of appropriate mitigation measures and given the number of potential breeding hollows that would remain unaffected, it is unlikely that the lifecycle of Turquoise Parrot would be significantly affected by the Proposal.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This vegetation within the footprint is generally disturbed and in poor condition. However, vegetation within the travelling stock reserve is in good condition and vegetation at the right-hand abutment although dominated by Callitris is in moderate condition.

The removal of this vegetation will remove both foraging and nesting resources for woodland species of bird. However, this amount of clearing is small in relation to the amount of similar habitat available in the wider region. Within the mapped extent of vegetation, coving a total area of 2,955 hectares, this clearing represents approximately 1.9% of the box gum woodland.

Given the tolerance of this species to disturbance and their preference for ecotone habitats (Higgins 1999), it is possible that newly crated edge habitats would be used by the species, particularly as a habitat corridor connecting more significant patches of vegetation.

Although operational impacts including erosion, sedimentation and destruction of habitat resulting from flooding may impact these species, the probability of flooding is very low. Further, as a result of the upgrade, this flood occurrence is less likely to occur and is also likely to be less severe that the current situation.

How is the proposal likely to affect current disturbance regimes?

The proposal would include clearing of native vegetation, which may allow invasive species to colonise these and adjacent areas during and after construction. Mitigation measures have been provided to minimise the likelihood of weed invasion, particularly by noxious species. A weed management plan would be prepared and implemented for the construction and operational phases and would outline weed control and management measures for the project. This would include ensuring that vehicles, equipment, boots and clothing are clean of soil and seeds prior to entering or leaving a site. Following construction, disturbed areas would be revegetated with locally indigenous species and a weed control program implemented.

Although operational impacts including erosion, sedimentation and destruction of habitat resulting from flooding may impact these species, the probability of flooding is very low. Further, as a result of the upgrade, this flood occurrence is less likely to occur and is also likely to be less severe that the current situation.

How is the proposal likely to affect habitat connectivity?

Within the study area woodland vegetation occurs as isolated remnants. However, even isolated trees can provide important links for fauna (NSW National Parks and Wildlife Service 2002a; NSW Scientific Committee 2002).

Although the majority of the proposed works are adjacent to existing clearings and infrastructure, clearing for construction would result in fragmentation of Woodland in the right-hand abutment area and in the travelling stock reserve (for an access track).

Due to the relatively large home range and mobility of this species, this loss of vegetation is unlikely to result in isolation of habitat. The ability to access adjacent habitats to the proposal will remain. Therefore, it is unlikely that local populations of this species would become fragmented or isolated from other areas of habitat as a result of the construction and operation of the proposal.

How is the proposal likely to affect critical habitat?

The Department of Environment and Conservation maintains a register of critical habitat. The land within the study area is not listed as a critical habitat and it is not considered critical to the survival of Turquoise Parrot.

Conclusion

The proposal is unlikely to have a significant affect on this species.

Microchiropteran Bats

Microchiropteran bats have been considered as a group based on the similarity of their habitats (Table G1).

Table G1 Threatened species of microchiropteran bat

Common name	Scientific Name	*TSC Act*[1]	*EPBC Act*[2]	Habitat	Records
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	Occurs in moderately wooded habitats and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins. Thought to forage below the forest canopy for small flying insects (Churchill 1998).	This species has not been recorded at Lake Keepit. The nearest records are approximately 20 km to the west in Kelvin State Forest (from 2002)
Little Pied Bat	*Chalinolobus picatus*	V		The species roosts in trees, caves, and abandoned mines and houses. Roost sites in caves are unusually warm and dry but they can tolerate roost temperatures of more than 40 degrees celsius. The Little Pied Bat has been recorded in dry open forest, open woodland, Mulga woodlands, chenopod shrublands, Callitris forest and mallee (Churchill 1998).	This species has not been recorded at Lake Keepit. The nearest records are approximately 30 km to the west near Vickery State Forest (from 2001)
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V		Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings. Forages within the canopy of dry sclerophyll forest. It prefers wet habitats where trees are more than 20 metres high (Churchill 1998).	This species has not been recorded at Lake Keepit. The nearest records are approximately 40 km to the east near Tamworth (from 1995)
Eastern Long-eared Bat (south-eastern form)	*Nyctophilus timoriensis*	V	V	Roosts in tree hollows and under loose bark in arid and semi-arid Australia (Strahan 1995).	This species has not been recorded at Lake Keepit. The nearest records are approximately 50 km to the west in Leard State Forest (from 2006) and 40 km to the east in Attunga state Forest (from 1997).
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	V		Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts in tree hollows. Thought to be a migratory species (Churchill 1998).	This species was recorded on site during current surveys

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This vegetation within the footprint is generally disturbed and in poor condition. However, vegetation within the travelling stock reserve is in good condition and vegetation at the right-hand abutment although dominated by Callitris is in moderate condition.

The removal of this vegetation will remove both foraging and roosting resources for microchiropteran bats. However, this amount of clearing is small in relation to the amount of similar habitat available in the wider region. Within the mapped extent of vegetation, coving a total area of 2,955 hectares, this clearing represents approximately 1.9% of the box gum woodland. While there may be some localised loss of breeding opportunities due to construction activities, large areas containing suitable roosting resources occur in areas adjacent to the construction zone.

There is a possibility that the Large-eared Pied Bat may roost within the current dam wall, and that construction activities would disturb their roost sites. However this species has not been recorded within 20 kilometres of the Keepit Dam.

With the implementation of appropriate mitigation measures and given the number of potential roosting sites that would remain unaffected, it is unlikely that the lifecycle of the bats would be significantly affected by the Proposal.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This vegetation within the footprint is generally disturbed and in poor condition. However, vegetation within the travelling stock reserve is in good condition and vegetation at the right-hand abutment although dominated by Callitris is in moderate condition.

The removal of this vegetation will remove both foraging and nesting resources for threatened microchiropteran bats. However, this amount of clearing is small in relation to the amount of similar habitat available in the wider region. Within the mapped extent of vegetation, coving a total area of 2,955 hectares, this clearing represents approximately 1.9% of the box gum woodland.

Although operational impacts including erosion, sedimentation and destruction of habitat resulting from flooding may impact these species, the probability of flooding is very low. Further, as a result of the upgrade, this flood occurrence is less likely to occur and is also likely to be less severe that the current situation.

How is the proposal likely to affect current disturbance regimes?

The proposal would include clearing of native vegetation, which may allow invasive species to colonise these and adjacent areas during and after construction. Mitigation measures have been provided to minimise the likelihood of weed invasion, particularly by noxious species. A weed management plan would be prepared and implemented for the construction and operational phases and would outline weed control and management measures for the project. This would include ensuring that vehicles, equipment, boots and clothing are clean of soil and seeds prior to entering or leaving a site. Following construction, disturbed areas would be revegetated with locally indigenous species and a weed control program implemented.

Although operational impacts including erosion, sedimentation and destruction of habitat resulting from flooding may impact these species, the probability of flooding is very low. Further, as a result of the upgrade, this flood occurrence is less likely to occur and is also likely to be less severe that the current situation.

How is the proposal likely to affect habitat connectivity?

Within the study area woodland vegetation occurs as isolated remnants. However, even isolated trees can provide important links for fauna (NSW National Parks and Wildlife Service 2002a; NSW Scientific Committee 2002).

Although the majority of the proposed works are adjacent to existing clearings and infrastructure, clearing for construction would result in fragmentation of Woodland in the right-hand abutment area and in the travelling stock reserve (for an access track).

Due to the relatively large home ranges and mobility of these species, this loss of vegetation is unlikely to result in isolation of habitat. The ability to access adjacent habitats to the proposal will remain. Therefore, it is unlikely that local populations of this species would become fragmented or isolated from other areas of habitat as a result of the construction and operation of the proposal.

How is the proposal likely to affect critical habitat?

The Department of Environment and Conservation maintains a register of critical habitat. The land within the study area is not listed as a critical habitat and it is not considered critical to the survival of threatened microchiropteran bats.

Conclusion

The proposal is unlikely to have a significant affect on these species.

Koala (*Phascolarctos cinereus*)

The Koala is listed as Vulnerable under the *Threatened Species Conservation Act 1995*

The Koala is an arboreal marsupial with fur ranging from grey to brown above, and is white below. It has large furry ears, a prominent black nose and no tail. It spends most of its time in trees and has long, sharp claws, adapted for climbing. Adult males weigh 6 - 12 kilograms and adult females weigh 5 - 8 kilograms (NSW National Parks and Wildlife Service 2002b).

Koalas are found in areas where there are suitable feed trees, ranging from open eucalypt woodlands to dense forests. Like other folivores, this species tends to be associated with forests growing on high-nutrient soils along river flats and drainage lines, most of which have been cleared for farmland (NSW National Parks and Wildlife Service 1999). The suitability of forest and woodland communities as habitat for Koalas is influenced by the size and species of trees present, soil nutrients, climate, rainfall and the size and disturbance history of the habitat patches. Koalas feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species (Moore & Foley 2000).

Koalas are generally inactive for most of the day, feeding and moving mostly at night. They spend most of their time in trees, but will descend and traverse open ground to move between trees. They are generally solitary, but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size (Lunney et al. 2000).

Young males reach sexual maturity at approximately two years, although they are generally excluded from mating by the dominant male. Females reach sexual maturity at approximately two years and can produce one offspring each year, generally in summer (Ellis et al. 2000).

Following birth, the young lives in the pouch for 6 months and on leaving the pouch it remains dependent on its mother, riding on her back. Young reach independence at about 12 months, although they can remain in the mother's home range for a further 2-3 years. After this period, young animals disperse to establish their own home range (Logan & Sanson 2003). Dispersal distances generally range from 1-11 kilometres, although movements in excess of 50 kilometres have been recorded (NSW National Parks and Wildlife Service 2002b).

In coastal northern New South Wales, populations have been estimated to range from one animal every 45 hectares to one every 4.5 hectares (average one every 20-25 hectares) (Melzer et al. 2000). Most young disperse at two to three years of age and females remain in their natal area. If no suitable habitat is found by young individuals then they become nomadic (Lunney et al. 2000).

The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In New South Wales it mainly occurs on the central and north coasts with some populations in the western region. It was historically abundant on the south coast of New South Wales, but now occurs in sparse and possibly disjunct populations (NSW National Parks and Wildlife Service 2003).

Koalas have been recorded approximately 15 km north-east of the dam wall (in 1987) and to the west in Kelvin State Forest (in 1993).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This vegetation within the footprint is generally disturbed and in poor condition. However, vegetation within the travelling stock reserve is in good condition and vegetation at the right-hand abutment although dominated by Callitris is in moderate condition. This habitat may be used by Koalas on an occasional basis, with the presence of feed trees, but is unlikely to be core Koala habitat based on earlier records. As such the removal of up to 18 hectares is unlikely to affect the lifecycle of the threatened species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Clearing of approximately 13.6 hectares, 18.0 hectares and 17.6 hectares of White Box Yellow Box Blakely's Red Gum Woodland is proposed for construction of Options B1, D2 and D3 respectively. This vegetation within the footprint is generally disturbed and in poor condition. However, vegetation within the travelling stock reserve is in good condition and vegetation at the right-hand abutment although dominated by Callitris is in moderate condition.

Within the study area a number of species or tree are considered to be feed tree species for the Koala. *Eucalyptus albens, E. camaldulensis* and *E. populnea* are all listed as koala feed tree species on Schedule 2 of SEPP 44 and have been recorded in the project locality. *Eucalyptus albe*ns would be cleared as a result of the proposal.

This amount of clearing is small in relation to the amount of similar habitat available in the wider region. Within the mapped extent of vegetation, coving a total area of 2,955 hectares, this clearing represents approximately 1.9% of the box gum woodland. This area would also not be considered core Koala habitat since there was no evidence of a resident or breeding population.

Although operational impacts including erosion, sedimentation and destruction of habitat resulting from flooding may impact these species, the probability of flooding is very low. Further, as a result of the upgrade, this flood occurrence is less likely to occur and is also likely to be less severe that the current situation.

How is the proposal likely to affect current disturbance regimes?

The proposal would include clearing of native vegetation, which may allow invasive species to colonise these and adjacent areas during and after construction. Mitigation measures have been provided to minimise the likelihood of weed invasion, particularly by noxious species. A weed management plan would be prepared and implemented for the construction and operational phases and would outline weed control and management measures for the project. This would include ensuring that vehicles, equipment, boots and clothing are clean of soil and seeds prior to entering or leaving a site. Following construction, disturbed areas would be revegetated with locally indigenous species and a weed control program implemented.

Although operational impacts including erosion, sedimentation and destruction of habitat resulting from flooding may impact these species, the probability of flooding is very low. Further, as a result of the upgrade, this flood occurrence is less likely to occur and is also likely to be less severe that the current situation.

How is the proposal likely to affect habitat connectivity?

Within the study area woodland vegetation occurs as isolated remnants. However, even isolated trees can provide important links for fauna (NSW National Parks and Wildlife Service 2002a; NSW Scientific Committee 2002).

Although the majority of the proposed works are adjacent to existing clearings and infrastructure, clearing for construction would result in fragmentation of Woodland in the right-hand abutment area and in the travelling stock reserve (for an access track).

Due to the relatively large home range and mobility of this species, this loss of vegetation is unlikely to result in isolation of habitat. The ability to access adjacent habitats to the proposal will remain. Therefore, it is unlikely that local populations of this species would become fragmented or isolated from other areas of habitat as a result of the construction and operation of the proposal.

How is the proposal likely to affect critical habitat?

The Department of Environment and Conservation maintains a register of critical habitat. The land within the study area is not listed as a critical habitat and it is not considered critical to the survival of Koalas.

Conclusion

The proposal is unlikely to have a significant affect on this species.

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