Review of Environmental Factors

Proposed construction and operation of conservation fencing and associated infrastructure and reintroduction of locally extinct mammals in the Pilliga State Conservation Area

A report prepared for Australian Wildlife Conservancy on behalf of NSW Office of Environment and Heritage

August 2017

Report No. 17.REF-010

Citation

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This project is being delivered under the NSW Governments *Saving our Species* program, which aims to secure threatened species in the wild for the next 100 years.

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Front Cover Image
Bilby (Photo: AWC)

Definitions & Acronyms used within this REF

APZ	Asset Protection Zone
ASL	Above Sea Level
AWC	Australian Wildlife Conservancy
BC Act	NSW Biodiversity Conservation Act 2016.
CFAI	Conservation Fencing and Associated Infrastructure
CMA	Catchment Management Authority
CPE	Canid Pest Ejector
DBH	Diameter at breast height
DOEE	Commonwealth Department of the Environment and Energy
EEC	Endangered Ecological Community
EMA	Extinct Mammal Agreement
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
EHMF	Ecological Health Monitoring Framework
ESD	Ecologically Sustainable Development
FM Act	NSW Fisheries Management Act 1994
HBT	Hollow-bearing tree
LEP	Local Environmental Plan
LGA	Local Government Area
Likely	Taken to be a real chance or possibility
LMZ	Land Management Zone
Locality	Means the area within a 10 km radius of the proposal.
Local population (migratory or nomadic fauna)	The population comprises those individuals that are likely to occur in the study area from time to time.
Local population (resident fauna)	The population comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to use habitats in the study area.
Local population (threatened flora)	The population comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.
Migratory species	A species specified in the schedules of the Commonwealth EPBC Act.
NES	National Environmental Significance
NP	National Park
NPWS	NSW National Park and Wildlife Service
NP&W Act	NSW National Parks and Wildlife Act 1974

NSC	Narrabri Shire Council
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
PoM	Plan of Management
Proposal	The area to be directly affected by the proposal. That is, the footprint of the proposal, including the construction and operation of the CFAI.
REF	Review of Environmental Factors
Region	Means a biogeographical region that has been recognised and documented such as the Interim Biogeographical Regions of Australia (IBRA) (Thackway and Creswell, 1995). The study area is located within the Brigalow Belt South Bioregion.
RFS	NSW Rural Fire Service
SCA	State Conservation Area
SEPP	State Environmental Planning Policy
SFAZ	Strategic Fire Advantage Zone
SMI	Statement of Management Intent
SOP	Standard Operating Procedure
SOS	Saving our Species
Study area	The study area includes the subject site and any additional areas that are likely to be affected by the proposal, either directly or indirectly.
Subject site	The area to be directly affected by the proposal. That is, the footprint of the proposal.
TEC	Threatened ecological community (includes those communities listed as vulnerable, endangered or critically endangered).
Threatened biota	Means those threatened species, endangered populations or endangered ecological communities considered known or likely to occur in the study area.
Threatened species	A species specified in the schedules of the BC Act, FM Act or the EPBC Act.

Declaration

This Review of Environmental Factors provides a true and fair review of the proposed activity in relation to its potential effects on the environment. It addresses to the fullest extent possible, all of the factors listed in Clause 228 of the Environmental Planning and Assessment Regulation 2000.

Signed: 

Name: Steve Sass

Delegation: Director/Principal Ecologist, EnviroKey Pty. Ltd.

Date: 14 June 2017

I have examined this REF and the certification and accept the REF on behalf of NSW Office of Environment and Heritage (OEH).

Signed ……

Name ……

Delegation ……

Date ……

Fees

OEH is the proponent for the proposal. No fees apply.

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NB: Appendices 1 to 13 are in a separate electronic document

Figures, Maps & Tables

1 INTRODUCTION

The NSW Government and Australian Wildlife Conservancy (AWC) have signed an historic agreement (Extinct Mammal Agreement) under which AWC is delivering scientific and land management services in the Pilliga State Conservation Area (SCA). The Extinct Mammal Agreement (EMA) ("A project to reintroduce locally extinct mammals", Agreement number: OEH-677-2014) gives effect to a commitment under the NSW Government's Saving our Species Program. Central to the EMA is a requirement for AWC, on behalf of the NSW Government, to establish a large feral predator-free (fenced) area into which mammal species listed as extinct in NSW will be reintroduced.

The proposal represents one of the most significant threatened species projects in Australia as it will deliver a substantial:

- increase in the population of at least six threatened mammal species, currently listed as extinct in NSW (Table 1); few proposals in Australia have delivered an ecological return on the scale anticipated by the EMA;
- benefit for other species, including species listed as threatened in NSW, as a result of the removal of feral animals and the restoration of ecosystem services (e.g. soil turnover by digging mammals) – for example, Eastern Pygmy-possum, Koala, Black-striped Wallaby, Pilliga Mouse.

Detailed assessment and planning for these reintroductions will occur as part of the Translocation Proposal, as required under the EMA.

Table 1: Global population of locally extinct mammals proposed for reintroduction into Pilliga SCA and the estimated increase to population size as a result of the proposal

Species	Global population estimate (2012)	Proposed Pilliga feral predator-free fenced area: potential population estimate*	% increase
Bridled Nailtail Wallaby	2,300	2,100	90%
Western Barred Bandicoot	3,000	1,550	50%
Bilby	10,000	850	8%
Brush-tailed Bettong	<18,000	2,900	16%
Plains Mouse	10,000	1,000 (600-5,800)	10%
Western Quoll	13,500	90 inside, 210 outside fence	1-2%

*Note: Population estimates are based on best available data, using information on home range and/ or density from areas of similar habitat and from other locations where feral predators are effectively controlled or absent. Populations are expected to vary considerably with rainfall.

EnviroKey Pty. Ltd (EnviroKey) was engaged by AWC to prepare a Review of Environmental Factors (REF) for the proposed construction and operation of the conservation fencing and

associated infrastructure (CFAI). The proposal is located about 46 km south-west of Narrabri and within the Narrabri Local Government Area (LGA). The regional setting detailing the study area used for this REF is shown in Figure 1. A larger scale representation of the approximate location of the proposal is in Figure 2. This is an approximate location due to the possibility of small shifts in the exact location of the CFAI to avoid significant large trees, any areas of extreme erosion risk, or any other sensitive environmental constraints. However, the proposal would remain within the general vicinity of that detailed within this REF.

For this REF, the '*Proponents Guidelines for the Review of Environmental Factors'* prepared by the Department of Environment and Climate Change (now NSW Office of Environment and Heritage (OEH)) was followed given that the proposal is located within Pilliga SCA and that OEH would be the proponent and determining authority (DECC, 2008b). The standard template for preparing a REF in lands reserved or acquired under the NSW *National Parks and Wildlife Act 1974* (NP&W Act) was also adopted in the preparation of this REF (DECCW, 2011).

Accordingly, this REF will:

- undertake an analysis of the environmental, economic, physical and social implications of the proposal; and
- describe the environmental impacts associated with the proposal and develop environmental safeguards for each environmental component where deemed necessary.

This REF has been prepared in accordance with the requirements of Section 111 of the *Environmental Planning and Assessment Act 1979* and Section 228 of the *Environmental Planning and Assessment Regulation 2000* specifying a "duty to consider environmental impact" and was prepared by suitably qualified and experienced personnel, details of which are provided in Appendix 1.

1.1 BRIEF DESCRIPTION OF THE PROPOSAL

The components of the proposal are outlined below.

- The construction of a 32.1 km feral predator-proof fence enclosing an area of 5,822 ha in the Pilliga SCA (Figure 2). The conservation fence will require a 12-15 m wide management trail to be cleared (6-7.5 m wide on each side of the fence), resulting in the removal of up to 48 ha of native vegetation. No internal fences will be constructed within the fenced area other than temporary fencing, if required, to facilitate the effective release of particular species as determined by the Translocation Proposal (e.g., a temporary holding pen). Any such temporary fencing would be installed and removed without material impact on the environment.
- Management of this area including the removal of feral animals and the implementation of some changes to fire management in relation to the area.
- The reintroduction of at least six threatened mammal species: Bilby, Western Barred Bandicoot, Bridled Nailtail Wallaby, Brush-tailed Bettong and Plains Mouse between March 2019 and April 2021; and the Western Quoll (date to be agreed).
- The establishment of an associated operations base (housing, infrastructure, services, etc.) in the Pilliga SCA, with a footprint of approximately11 ha outside the feral predator-free area which is predominately an Asset Protection Zone (APZ). The proposed layout is shown in Figure 3. Most of the 11 ha would be modified, rather than totally cleared. For the purpose of this REF and in line with OEH definitions of 'clearing', this will be assessed assuming total loss of 11 ha.

- Establishment of a new management trail about 8.2 km long (Figure 2); about 3.3 ha of vegetation would be removed.
- The total impact area for this proposal is approximately 62 ha.

1.2 PROPONENT'S DETAILS

The proponent for the proposal is NSW OEH. Full details of the proponent are provided in Table 2.

Table 2: Proponent's details

Item	Details
Proponent	NSW Office of Environment and Heritage (OEH)
Contact	Michael Wright, Executive Director, OEH (NPWS)
Address	PO Box A290, Sydney South, NSW 1232
Phone	+61 (0)2 9585 6300
Facsimile	
Email	michael.wright@environment.nsw.gov.au

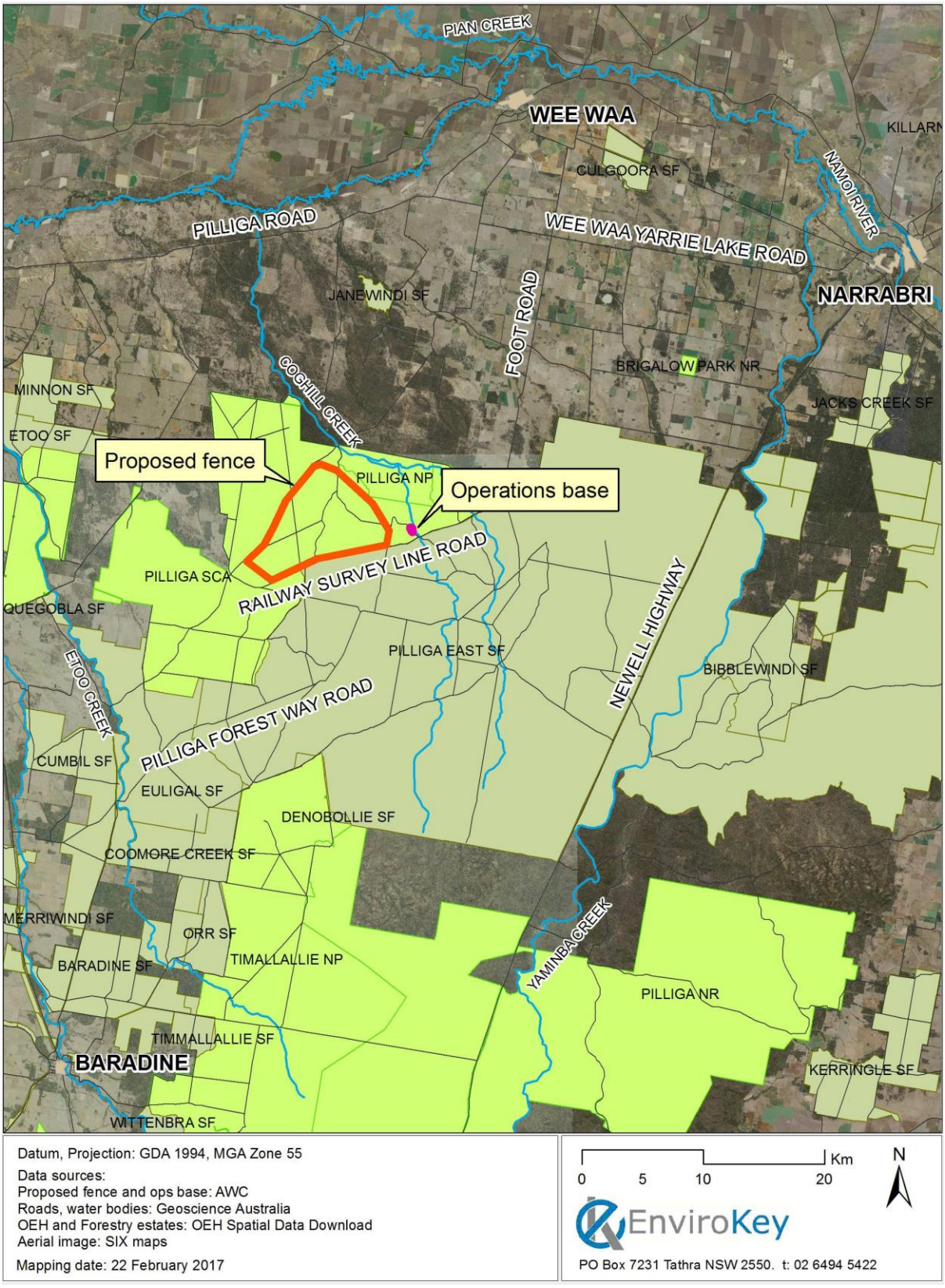


Figure 1: Regional setting of the study area applied to this REF

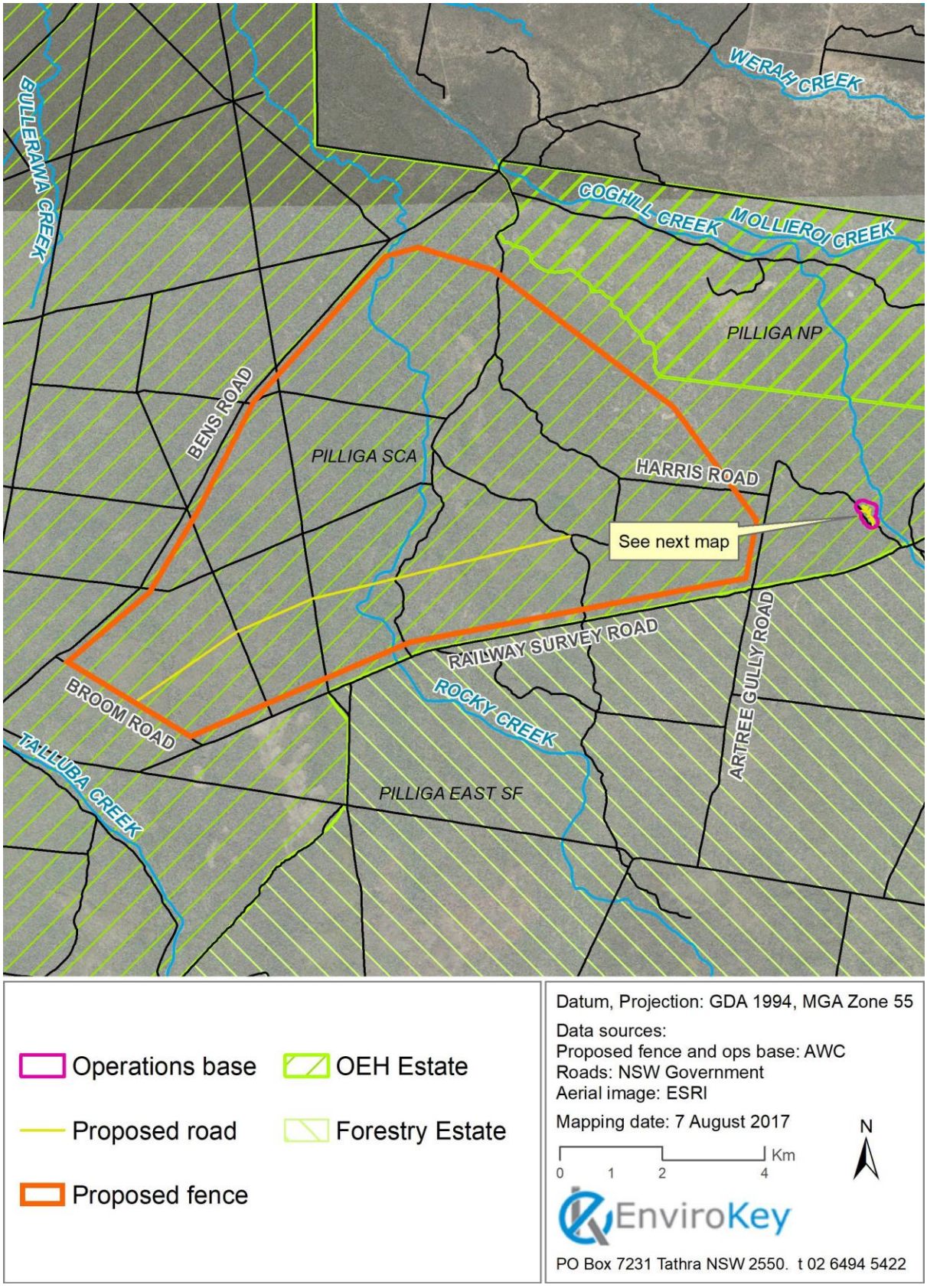


Figure 2: Location of the proposal: conservation fence for the feral predator-free area, operations base and internal management trail

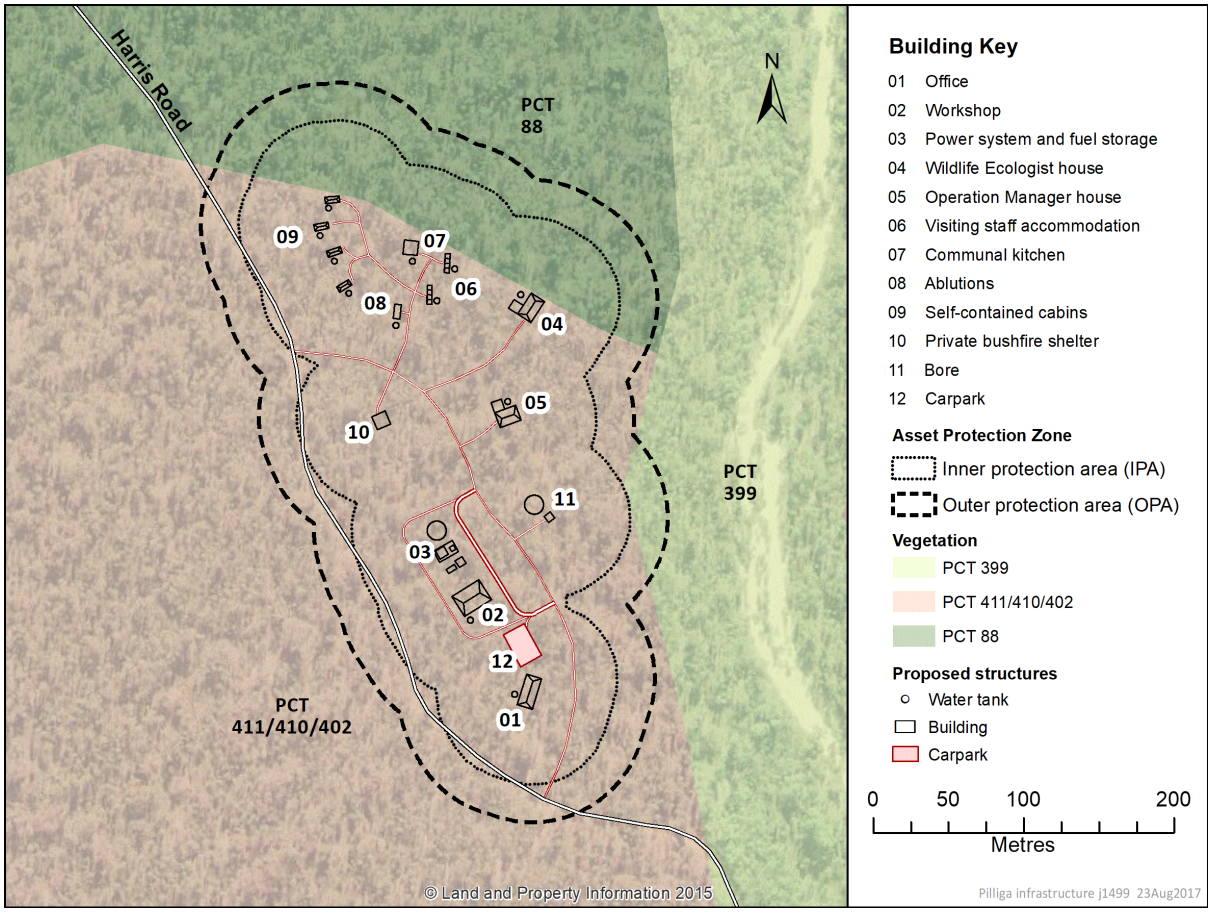


Figure 3: Layout of proposed operations base

2 PERMISSIBILITY

2.1 LEGAL PERMISSIBILITY

The NSW Government and Australian Wildlife Conservancy (AWC) have signed an historic agreement (Extinct Mammal Agreement) under which AWC is delivering scientific and land management services in the Pilliga State Conservation Area (SCA). The Extinct Mammal Agreement (EMA) ("A project to reintroduce locally extinct mammals", Agreement number: OEH-677-2014) gives effect to a commitment under the NSW Government's Saving our Species policy. Central to the EMA is a requirement for AWC, on behalf of the NSW Government, to establish a large feral predator-free (fenced) area into which mammal species listed as extinct in NSW will be reintroduced.

2.1.1 NSW Biodiversity Conservation Act 2016 and National Parks and Wildlife Act 1974

On the 25 August 2017 the *Biodiversity Conservation Act 2016* (BC Act) commenced and plants and animals are now regulated under the BC act. Prior to this licensing was authorized under the provisions of the *National Parks and Wildlife Act 1974*.

The BC Act is administered by OEH and provides the basis for the legal protection of plants and animals in NSW. Unless a license is obtained under the BC Act, it is an offence to harm any animal or plant that is protected or is a threatened species or ecological community.

Activities in accordance with Part 5 Assessment of the *National Parks and Wildlife Act 1974* do not require a license under the NPW Act. The NPW Act also protects Aboriginal heritage values.

The proposal is broadly consistent with the objects of the BC and NPW Acts.

Objects of the BC Act (s.1.3)

The activity will contribute to:

(a) conservation of biodiversity and ecological integrity

(b) facilitate ecological sustainable development

(c) improve and share knowledge including local and Aboriginal knowledge, about the status and values of biodiversity and of ecosystem services and the effectiveness of conservation actions

Objects – Reserve management principles NPW Act (s.30E – 30K)

The activity is consistent with the management principles of national parks under sections 30E and state conservation areas under section 30G of the NPW Act, particularly:

- the conservation of biodiversity and maintenance of ecosystem function
- the protection of ecological integrity
- provision for appropriate research and monitoring.

Relevant section of a plan of management

The proposal is consistent with the *Pilliga Outwash Parks Statement of Management Intent 2017*, which was amended to provide permissibility for this project.

Leasing, licensing and easement provisions

The proposal would not conflict with any of these provisions of the BC of NPW Act. Because OEH is the project proponent, no leases, licenses or easements would be required.

Management powers and responsibilities of NPWS

The proposal is consistent with the management powers and responsibilities specified within the Act. For areas protected under the NP&W Act, Section 8 of the Act enables the Chief Executive of NPWS to:

- arrange for works connected to the management and maintenance of parks, and the preservation, protection and care of native fauna and flora;
- undertake scientific research;
- promote educational activities.

Section 12 of the NP&W Act lists the powers and functions of NPWS. The most directly relevant to this proposed action are:

- the conservation and protection of wildlife (including threatened species, populations and ecological communities, and their habitats);
- the identification, conservation, protection and prevention of damage to Aboriginal objects;
- the identification and protection of buildings, places and objects of non-Aboriginal cultural values on reserved land;
- the conduct of research monitoring;
- the undertaking of public education.

2.1.2 NSW Environmental Planning and Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) forms the legal and policy platform for development assessment and approval in NSW and aims to, inter alia, 'encourage the proper management, development and conservation of natural and artificial resources'.

The EP&A Act provides the framework for environmental planning in NSW and includes provisions to ensure that proposals which have the potential to significantly affect the environment are subject to detailed assessment.

The proposal will be determined by OEH under Part 5 of the Act. OEH, as the determining authority, must 'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity' pursuant to Section 111 of the Act. Clause 228 of the *Environmental Planning & Assessment Regulation 2000* (EP&A Regulation) identifies matters that 'must be taken into account concerning the impact of an activity on the environment'.

Section 5A of the EP&A Act contains seven factors to be considered by determining authorities when considering the significance of impacts on threatened biota associated with activities under Part 5 of the Act (the '5-part test'). Should the 5-part test determine that a '*significant effect*' on any threatened biota listed under the BC Act is likely, then the authority must prepare a Species Impact Statement. Species which occur or have the potential to occur in the study area have been assessed using the 5-part test (Appendix 7). The proposal is *unlikely* to have a *significant effect* on any threatened biota listed under the BC Act.

2.1.3 NSW Wilderness Act 1987

The objectives of the NSW *Wilderness Act 1987 are*:

- to provide for the permanent protection of wilderness areas;
- to provide for the proper management of wilderness areas;
- to promote the education of the public in the appreciation, protection and management of wilderness.

The proposal is not located within an area listed under the NSW *Wilderness Act 1987*.

2.1.4 NSW Biodiversity Conservation Act 2016

The NSW *Biodiversity Conservation Act 2016* (BC Act) provides legal protection for plants and animals of conservation significance. The BC Act aims to, inter alia, 'maintain a healthy, productive and resilient environment….consistent with the principles of ecological sustainable development'. It provides for:

- the listing of threatened plans and animals, populations and ecological communities, species extinct in the wild and key threatening processes;

the preparation and implementation of strategies to achieve the long-term security of listed species and communities guidelines for the preparation of an Assessment of Significance. The BC Act has been addressed in this REF by undertaking database searches and desktop analysis for any threatened species or communities previously recorded within the locality, and targeted field surveys. Key threatening processes relevant to the proposal have been identified as part of assessment of potential impacts. Assessments of significance for threatened species and ecological communities are provided in Appendix 7. The proposal is *unlikely* to have a *significant effect* on any threatened biota listed under the BC Act.

Drafting this REF coincided with the transition in legislation from the *Threatened Species Conservation Act 1995* (TSC Act) to the BC Act. Terminology and Assessment of Significance have been updated to be consistent with the new BC Act.

2.1.5 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) enables the Australian Government to join with the states and territories in providing a national scheme of environment and heritage protection and biodiversity conservation to ensure that actions likely to cause a *significant impact* on matters of national environmental significance (NES) undergo an assessment and approval process. Under the Act, an action includes a project, undertaking, development or activity.

An action that has, or is likely to have, a significant impact on a matter of NES may be undertaken only in accordance with the prior approval of the Australian Government Minister for the Environment (DOTE, 2013).

The nine matters of NES that are protected under the EPBC Act are:

- Listed threatened species and ecological communities;
- Listed migratory species;
- Wetlands of international importance;
- Commonwealth marine environment;
- World heritage properties;
- National heritage places;

- The Great Barrier Reef Marine Park;
- Nuclear actions; and
- A water resource, in relation to coal seam gas development and large coal mining development.

The Significant Impact Guidelines for the EPBC Act (DOTE, 2013) set out criteria to assist in determining whether an action requires approval and in particular, whether a proposed action is likely to have a significant impact on a matter of NES.

All mammal species to be reintroduced are listed under the EPBC Act. The likelihood that any additional threatened species or ecological communities or any migratory species occur in the vicinity of the proposal was assessed and results are tabulated in Appendix 8. The resulting list of species that are likely to occur within the vicinity of the proposal is in Table 3. Each species in Table 3 was assessed against the significant impact guidelines (Appendix 8). The proposal is *unlikely* to have a *significant impact* on any matter of NES in accordance with the Significant Impact Criteria (Appendix 8) (DOTE, 2013). The assessments also showed that the activity would deliver substantial positive benefits for the species.

Table 3: Species listed as Critically Endangered, Endangered, Vulnerable or Migratory under the EPBC Act that are likely to be within the vicinity of the proposed activity and that were assessed against the significant impact criteria (Appendix 8)

Species	EPBC category
Western Quoll (*Dasyurus geoffroii*)	Vulnerable
Western Barred Bandicoot (*Perameles bougainville bougainville*)	Endangered
Bilby (*Macrotis lagotis*)	Vulnerable
Northern Hairy-nosed Wombat (*Lasiorhinus krefftii*)	Endangered
Brush-tailed Bettong (*Bettongia penicillata*)	Endangered
Bridled Nailtail Wallaby (*Onychogalea fraenata*)	Endangered
Plains Mouse (*Pseudomys australis*), listed as Plains Rat	Vulnerable
Fork-tailed Swift (*Apus pacificus*)	Migratory
Malleefowl (*Leipoa ocellata*)	Vulnerable
Painted Honeyeater (*Grantiella picta*)	Vulnerable
Regent Honeyeater (*Anthochaera Phrygia*)	Critically Endangered
Satin Flycatcher (*Myiagra cyanoleuca*)	Migratory
Superb Parrot (*Polytelis swainsonii*)	Vulnerable
White-throated Needletail (*Hirundapus caudacutus*)	Migratory
Corben's Long-eared Bat (*Nyctophilus corbeni*)	Vulnerable
Large-eared Pied Bat (*Chalinolobus dwyeri*)	Vulnerable
Koala (*Phascolarctos cinereus*)	Vulnerable
Pilliga Mouse (*Pseudomys pilligaensis*)	Vulnerable
Commersonia procumbens, listed as *Androcalva procumbens*	Vulnerable
Tylophora linearis	Endangered

2.1.6 NSW Fisheries Management Act 1994

The NSW *Fisheries Management Act 1994* (FM Act) aims to conserve fish stocks, key habitats, threatened species, populations and ecological communities of fish and marine vegetation. It also aims to promote viable commercial fishing, aquaculture industries and recreational fishing. The Pilliga SCA is within the Lower Darling Aquatic Ecological Community, listed as endangered under the *Fisheries Management Act 1994*.

As a public authority, the OEH does not require a permit for dredging and reclamation works within 'water land' under Clause 200 (1) of the FM Act. Under this act, 'water land' means land submerged by water, whether permanently or intermittently or whether forming an artificial or natural body of water. Therefore, some portions of the proposal would be classified as 'water land' which would be submerged intermittently as a result of flooding along with the drainage line crossings as water land is also generally taken to include all drainage lines and waterways that are indicated on 1:25,000 topographic maps. Under the Act, 'reclamation work' means using any material (such as sand, soil, silt, gravel, concrete, oyster shells, tyres, timber or rocks) to fill in or reclaim water land, or depositing any such material on water land for the purpose of constructing anything over water land (such as a fence). Therefore, the conservation fence which would be constructed as part of the proposal would, where it crosses drainage lines, fall within this definition.

Under Clause 199 of the FM Act, a public authority must give the Minister written notice of any proposed dredging or reclamation work in 'water land' and must consider any matters concerning the proposed work that are raised by the Minister within 28 days after the giving of the notice (or such other period as is agreed between the Minister and the public authority). Written notice of the proposal was given to the Minister in March 2017 (see Section 3.2) and the response requested the following points be addressed in this REF:

- any blockages to fish passage;
- any potential loss of riparian vegetation;
- rehabilitation of sites
- sediment and erosion controls; and
- any issues relating to threatened species, populations and ecological communities.

All of these points have been addressed in this REF.

2.1.7 NSW Heritage Act 1977

The NSW *Heritage Act 1977* defines 'environmental heritage' and can include places, buildings, works, relics, moveable objects and precincts. A property is a heritage item if it is:

- listed in the heritage schedule of the local council's Local Environmental Plan (LEP);
- listed on the State Heritage Register, a register of places and items of particular importance to the people of NSW; and
- listed in the National Heritage Database.

Heritage items are considered in this REF in Section 5.11. No heritage sites will be impacted by the proposal.

2.1.8 State Environmental Planning Policy No. 44 – Koala Habitat Protection

State Environmental Planning Policy (SEPP) No. 44 encourages the conservation and management of natural vegetation areas that provide habitat for Koalas to ensure that permanent free-living populations will be maintained over their present range across 107 local government areas (LGAs). Local councils listed under Schedule 1 of SEPP 44 cannot

approve development in an area affected by the policy without an investigation of core Koala habitat. The policy provides the state-wide approach needed to enable appropriate development to continue, while ensuring there is ongoing protection of Koalas and their habitat. Narrabri LGA is listed within Schedule 1 of this SEPP. However, Part 1, Sec.5 confirms that SEPP44 does not apply on land dedicated or reserved under the NP&W Act. Therefore, SEPP44 does not apply to the proposal. However, potential impacts on, and benefits for, Koalas are considered throughout this REF.

2.1.9 Rural Fires Act and bushfire management plans

The Pilliga Outwash Statement of Management Intent states that large-scale fire in the Pilliga Outwash is a rare event. Notwithstanding this, the NPWS fire management strategies identify the fire programs for vegetation within the outwash area, and the requirement for asset protection including cultural and historic heritage, and built infrastructure. The CFAI is part of the built infrastructure for the Pilliga Outwash area, and a Strategic Fire Advantage Zone (SFAZ) and an Asset Protections Zone (APZ) for the conservation fence and the operations base are part of this proposal. Management of these zones mitigates the risk to the CFAI by incorporating strategic prescribed burns along a relatively narrow strip immediately adjacent to the fence, and near the operations base. These zones are consistent with the fire management strategies as identified in the Statement of Management Intent.

Vegetation within the operations base will be managed to comply with requirements for an Inner Protection Area and an Outer Protection Area consistent with the Rural Fires Act. Fire management is discussed in further detail in Section 4.3.8.

2.2 CONSISTENCY WITH OEH POLICY AND PROGRAMS

2.2.1 Statement of Management Intent: Pilliga NP and Pilliga SCA

The NP&W Act requires that all activities on reserved land are consistent with an adopted plan of management for the area. Under sections 81 and 81A of the NP&W Act, all operations in the park must be in accordance with the plan of management (PoM). There is no PoM for the EMA project area. In the absence of a PoM, a Statement of Management Intent (SMI) provides basic management principles and priorities for a park in the period before a PoM is developed and is consistent with the intent of the NP&W Act and the 'precautionary principle' within Ecologically Sustainable Development (ESD). The Pilliga Outwash Parks SMI covers the EMA project area and has been updated to specifically include the reintroduction of locally extinct mammals project in Pilliga SCA and Pilliga National Park. The proposed activity is consistent with the statement of management intent.

2.2.2 Managing Parks prior to Plan of Management Policy

Under the OEH policy 'Managing Parks Prior to Plan of Management', parks may be managed under a statement of management intent. The proposed activity is not consistent with policy which states that that new structures such as workshops, offices, toilet blocks and utilities will not be constructed. However, NPWS is unable to prepare a plan of management for the Pilliga SCA and Pilliga National Park. Instead, an updated statement of management intent has been prepared that specifically includes the EMA project. The proposal has the endorsement of the Minister for the Environment.

2.2.3 Saving our Species

The proposal is consistent with the Saving our Species (SOS) program (OEH, 2016). The key objectives of SOS are:

- to maximise the number of threatened species in NSW that can be secured in the wild for the next 100 years;
- to control key threats facing threatened plants and animals.

The EMA, together with this proposal, is a key partnership between the NSW Government and AWC under SOS to reintroduce regionally extinct mammals into Pilliga SCA. The proposal will also lead to the removal of feral cats, foxes, feral pigs, feral goats and rabbits from within the conservation fenced area, thus benefiting other threatened species.

2.2.4 Beekeeping Policy

Beekeeping is allowed in some national parks but it must be balanced with conservation values and the needs of other park users.

The Beekeeping Policy provides that beekeeping is generally allowed in areas reserved under the NP&W Act when it is recognized as an existing use (i.e. it was carried out before the land was reserved). Beekeeping on a park, where permitted, must occur in accordance with an apiary licence under the NP&W Act and only if the beekeeper is registered as an apiarist under the *Apiaries Act 1985*.

This Beekeeping Policy further aims to:

- provide clear guidelines for beekeeping in parks;
- balance NPWS's environmental responsibilities under the NP&W Act and the apiary industry's need for access to parks;
- guide where beekeeping may be suitable in parks and a mechanism for the relocation of existing sites where apiary activities may result in adverse impacts on the natural and cultural values of a park.

In particular, the Beekeeping Policy specifically provides that NPWS may require beehives to be moved. NPWS may relocate an existing beekeeping interest if:

- the beekeeping is likely to affect safety of the public;
- an access route needs to be closed or altered; or
- there is another park-management or conservation purpose to consider.

In addition, beekeeping sites will, wherever possible, be relocated out of any area that is a declared Wilderness Area.

The current proposal involves establishing in the Pilliga SCA a 5,822-hectare feral predator-free area into which at least six threatened mammal species – all listed as extinct in NSW – will be reintroduced. The 5,822-hectare area will be surrounded by a specially designed feral-proof fence. The area will be subject to intensive feral animal control (approved shooting, trapping and baiting programs) prior to the mammal reintroductions. Maintaining the integrity of the feral predator-free area is essential to the success of the project and will involve:

- regular patrols and maintenance of the fence;

- excluding public access, except in accordance with guided visitor programs which will not commence until after the threatened mammal reintroductions are successful; and
- should an incursion occur, delivering an immediate response which will likely involve the delivery of an approved shooting, trapping and baiting program.

The reintroduction of threatened mammals will be carried out in conjunction with an intensive program of scientific monitoring and research.

It is proposed that the apiary sites currently located within the proposed feral predator-free area will be removed and relocated outside the fenced area. The removal and relocation will be carried out in consultation with apiarists to ensure the most suitable alternate locations are identified in a consistent and coordinated manner. Consultation with apiarists has commenced and is ongoing.

The proposed removal and relocation of beehives is consistent with the Beekeeping Policy.

- The removal and relocation of beehives is necessary to ensure the delivery of a critical **conservation purpose** – the reintroduction of six nationally threatened mammals and associated benefits (including the generation of scientific knowledge). To highlight the importance of this conservation purpose, the NSW Government is investing over $40 million dollars at the Pilliga and in two related projects.
    - The success of the reintroductions is critically dependent on maintaining the feral predator-free status of the fenced area – i.e. preventing any incursion of foxes and/or cats.
    - The greatest risk of incursion relates to access, particularly the use of gates. AWC has extensive experience in managing fenced, feral predator-free areas – almost all of the fox/cat incursions at AWC fenced areas have been a result of a gate failure (mechanical or human error). It is therefore essential that access to the fenced area – i.e. use of the gates – limited and restricted to management personnel only (including, after the successful reintroduction of threatened mammals, management personnel conducting visitor programs).
    - Providing third parties – whether apiarists or others – with access to the fenced area represents an unacceptably high risk to the success of the project. One gate failure could set the project back years and, importantly, could have a significant impact on the survival of several threatened species; the cost to remedy the consequences of any gate failure would be extremely high. The adverse impacts of an incursion extend to economic loss for the local region should visitor programs and associated investments be compromised.
    - Alternatives have been considered including whether it is possible to put in place a regime whereby apiarists access the property only in the company of AWC staff. However, such alternatives are not proposed to be adopted because: (a) it is inconsistent with the absolute need to limit the extent of access; (b) it is impracticable, and inconsistent with the intense demand on management resources required for delivery of this project, to provide that AWC staff will be available to accompany apiarists; (c) a reasonable alternative exists whereby sites can be relocated outside the fenced area; and (d) the potential liability attaching to an apiarist should an incursion occur as a result of his or her access would likely be prohibitive.
- The proposed removal of sites is also consistent with the Beekeeping Policy in that it is necessary because of the effective **closure of access roads**, being the roads that traverse the area to be fenced.
- The proposed removal and relocation of beekeeping sites is also necessary to ensure the safety of apiarists. Management of the fenced area will involve delivery of

intensive land management operations including approved shooting and baiting programs. Minimising the risk to apiarists as result of these programs would, in effect, involve limited access in the company of AWC staff which, for reasons identified above, is not feasible, especially given the existence of reasonable alternatives.

As indicated above, the NSW Government is making a substantial investment in the delivery of the proposed project. The relocation of 13 apiary sites to nearby locations within the Pilliga SCA is a reasonable and necessary step, consistent with the Beekeeping Policy, to protect this investment by minimizing the critical risk to the project (the incursion of feral predators). The range of the bees would, in cases where the beehives are located close to the boundary of the fenced area, still extend into the fenced area, further minimizing the impact of the relocation.

2.2.5 NSW permits, licenses and approvals for activities related to wildlife

Under the NP&W Act and the BC Act, licenses are required to harm (take), pick or possess threatened species within NSW and to import threatened species into the state. Scientific licenses and import permits (both administered by the OEH) and Animal Research Authorities (administered by the NSW Department of Primary Industry) will be applied for in conjunction with the submission of the Translocation Proposal for the species to be reintroduced to the proposed feral predator-free area.

Additional licenses, permits or approvals that may be required under the EPBC Act and under legislation in operation in any of the other Australian states that may be involved in the wildlife translocations are outlined in Section 2.3.3.

2.2.6 Other policies

Other NSW park management policies and procedures may be applicable to the proposed activity and will be complied with in delivering the proposal. Policies which may be relevant include:

- Fire Management Manual
- Policy for the translocation of threatened species in NSW
- Park Signage Manual
- Signage policy
- Visitor safety policy
- Park visitor facilities policy
- Park facilities manual
- Roads policy
- Roads manual
- Construction assessment procedures
- Vehicle access policy
- Wild dog policy
- Neighbour relations policy
- Boundary fencing policy
- Aboriginal partnerships policy
- Protecting Aboriginal Cultural Heritage policy
- Cultural heritage conservation policy
- Law enforcement policy
- Beekeeping policy

- Access to inholdings policy
- Scientific rigour policy
- All Threat Abatement Plans

2.3 Review of environmental factors guidelinesOTHER RELEVANT LEGISLATION, POLICIES OR PLANS

2.3.1 Ecologically Sustainable Development

Ecologically sustainable development (ESD) involves the effective integration of social, economic and environmental considerations in decision-making processes. In 1992, the Commonwealth and all state and territory governments endorsed the *National Strategy for Ecologically Sustainable Development*. In NSW, the concept has been incorporated in legislation such as the EP&A Act and Regulation.

For the purposes of the EP&A Act and other NSW legislation, the Intergovernmental Agreement on the Environment (1992) and the *Protection of the Environment Administration Act 1991* outline the following principles which can be used to achieve ESD.

(a) The precautionary principle: that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions can be guided by:

(i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and

(ii) an assessment of the risk-weighted consequences of various options.

(b) Inter-generational equity: that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

(c) Conservation of biological diversity and ecological integrity: that conservation of biological diversity and ecological integrity should be a fundamental consideration.

The aims, structure and content of this REF are guided by these principles. The precautionary principle has been adopted in the assessment of impact; all potential impacts have been considered and mitigated where a risk is present. Where uncertainty exists, measures have been suggested to address it.

2.3.2 Narrabri Local Environmental Plan 2012

The proposal is located in the Narrabri LGA and is subject to the Narrabri Local Environmental Plan 2012 (LEP). The site is zoned as E1 National Parks and Nature Reserves. Uses authorised by the NP&W Act are permitted without council consent.

The aims of the Narrabri LEP include but are not limited to:

- to encourage the orderly management, development and conservation of resources by protecting, enhancing and conserving:
    - land of significance for agricultural production;
    - timber, minerals, soil, water and other natural resources;
    - areas of high scenic or recreational value;

  - native plants and animals including threatened species, populations and ecological communities and their habitats; and
  - places and buildings of heritage significance;
- to provide a choice of living opportunities and types of settlements;
- to facilitate development for a range of business enterprise and employment opportunities;
- to ensure that development is sensitive to both the economic and social needs of the community, including the provision of community facilities and land for public purposes.

The proposal is consistent with the aims of the LEP.

2.3.3 Permits, licenses and approvals from non-NSW administrations

The need for approval from the Commonwealth Government to take and liberate wildlife under the EPBC Act will be discussed with the relevant authorities and approval applied for if required.

The threatened species to be reintroduced are likely to be sourced from South Australia, Victoria, Queensland, Western Australia and the Northern Territory, and each jurisdiction administers a system of export permits. Relevant ones will be applied for in conjunction with the submission of the Translocation Proposal.

3 CONSULTATION

AWC is committed to discussing the proposal with all relevant stakeholders and government agencies and has introduced the proposal to them. This section provides commentary on the discussions and responses if relevant to this REF. Any detailed response from stakeholders or government agencies is provided in Appendix 3.

3.1 Forestry Corporation NSW

A letter outlining the proposal was sent to Mr Conan Rossler, District Manager at Baradine on 17 March 2017. An email response was received from Dr Patrick Tap, Senior Field Ecologist, Forestry Corporation NSW on 24 March 2017. That correspondence included a request for GIS shapefiles of the proposed CFAI, and the opportunity to comment on the REF once prepared.

3.2 NSW Department of Primary Industries (Fisheries)

A letter outlining the proposal was sent to Mr David Ward, Fisheries Manager, Calala NSW on 17 March 2017.

A formal response was received on 17 March 2017. In summary, the DPI Fisheries requested that the following points be addressed in the REF:

- any blockages to fish passage;
- any potential loss of riparian vegetation;
- rehabilitation of sites;
- sediment and erosion controls; and
- any issues relating to threatened species, populations and ecological communities.

DPI Fisheries also provide advice to AWC in relation to approvals/permits that may be required. Notification to the Minister for Fisheries must be undertaken for any proposed work in 'waterland' in accordance with sections 198-203 of the FM Act. Fish passage will not be blocked: the fence is designed to allow small aquatic animals to pass, and there are no records of large fish in the ephemeral waterways crossed by the proposed fence.

The response from DPI Fisheries is provided in Appendix 3 and the contents of that response have been considered within this REF.

3.3 Other consultation

AWC has completed additional consultation with a variety of organisations. A summary is provided in Table 4.

Table 4: A summary of consultation carried out by AWC with regard to the proposal

Organisation	Date	Attendees	Synopsis
Narrabri Council	14th March 2017	Mayor, Deputy Mayor, Heads of Departments	AWC provided a presentation to the council on the proposal, and followed with a Q&A session. Council were very supportive, and have offered to facilitate signage (outside the boundaries of the park), inclusion in the Visitor Information

Organisation	Date	Attendees	Synopsis
			Centre, and to help support the delivery of the proposal through introductions to community groups.
Narrabri Local Aboriginal Land Council	16th March 2017	Lynn Trindall (CEO)	AWC provided an overview of the proposal, and on AWC generally. Lynn offered to assist where possible – although noted that the Narrabri LALC had only a limited role in the area of the Pilliga proposal site.
Craig Trindall Consulting	16th March 2017	Craig Trindall	Craig works with indigenous children in providing mentoring and guidance. AWC provided, by phone, an overview of the proposal. AWC will consult with Craig on the development of support and mentoring packages to assist with the employment of indigenous personnel.
Gawambaraay Pilliga Co-Management Committee	15th March 2017	NPWS & indigenous representatives from Coonabarabran, Pilliga and Wee Waa Local Aboriginal Land Councils	AWC provided an overview of the proposal, focusing on the indigenous engagement opportunities, employment and cultural development. The co-management committee indigenous representatives offered to (outside of the committee) meet with AWC to provide advice on employment and engagement.
Chamber of Commerce & Industry	14th March 2017	Russell Stewart (President)	Russell was involved in the official launch of the Pilliga EMA project, with the AWC CE, Local MP and media. Russell has offered to assist AWC with sourcing local suppliers for products, introducing AWC to Narrabri industries and providing CCI support where possible.
Coonabarabran Indigenous Community	15th March 2017	Maureen Sulter	Maureen met with AWC to further discuss the opportunities for Gamileroi peoples – language, culture and employment. AWC will consult with Maureen on a regular basis to develop interpretive material that includes information such as language of the Gamileroi peoples.
Wee Waa Local Aboriginal Land Council	April 2017	CEO	A letter advising of the proposal, along with an AWC newsletter was provided inviting discussion on the

Organisation	Date	Attendees	Synopsis
			proposal, and an invitation to participate in the indigenous heritage survey. Members of the WWLALC have participated in the cultural heritage survey.
Pilliga Local Aboriginal Land Council	April 2017	CEO	A letter advising of the proposal, along with an AWC newsletter was provided inviting discussion on the proposal. Members of the Pilliga LALC have participated in the cultural heritage survey.
Narrabri Rotary	10th March 2017	Wayne Wheeler (President)	AWC consulted with Wayne by phone – and provided documentation and an overview of the proposal, AWC and opportunities to engage with the local community. Wayne will liaise with AWC to provide local community presentations.
Apiary Industry	2017	AWC has been engaging with Apiarists with registered sites across the EMA project area, with a priority on the sites within the proposed fenced area.	AWC and OEH have identified the Apiarists that hold licenses for sites within the project area, and specifically within the fenced area. AWC has commenced engagement with the Apiarists, and this engagement will be ongoing.
Neighbours	2016/2017	Neighbours	AWC, in collaboration with OEH, has engaged with neighbouring landholders to provide advice on the proposal and contact details for relevant AWC staff. AWC continues to engage with neighbours where delivery of activities requires, as well as providing regular updates on project development.

AWC will maintain engagement with a range of stakeholders throughout the proposed activity including in the public engagement period.

4 THE PROPOSAL

4.1 ANALYSIS OF THE OPTIONS

4.1.1 Option 1: Do nothing

The 'do nothing' option is an option that OEH are legally obliged to consider under the EP&A Act. With consideration of the 'do nothing' option, the EMA would not be implemented and the CFAI would not be constructed or operated.

Advantages

- No capital expense
- No negative impacts to native vegetation and habitat
- No impact on existing apiary access.

Disadvantages

- Feral predators will continue to have a major negative impact on biodiversity. In particular, it is likely threatened species in the proposal area, such as Black-striped Wallaby and Rufous Bettong, will continue to decline.
- Feral herbivores will continue to have a major negative impact on biodiversity. As a consequence, threatened species in the project area will continue to decline.
- Lost opportunity to reintroduce extinct mammals into the NSW national parks estate. The Pilliga is an important site in this context given its relatively high rainfall compared to other locations in far western NSW.
- A lost opportunity to restore ecosystem processes provided by the regionally extinct mammals.
- Lost opportunity for a significant economic benefit for the region.
- Lost opportunity for increased park visitation by members of the community who wish to see Bilbies, Bettongs and other regionally extinct mammals in the wild.
- Lost opportunity to advance scientific knowledge in relation to key threatening processes (feral animals) and biodiversity.
- Significant government/community/stakeholder support for the proposal would not be realised.
- NSW Government commitment to Saving our Species policy would not delivered and the terms of the EMA not implemented.

4.1.2 Option 2: Reintroduce extinct mammals without the conservation fencing

Option 2 would see the attempted reintroduction of mammals that are listed as extinct in NSW, primarily due to impacts from feral predators and competition with introduced herbivores, in the absence of conservation fencing. A nearby operations base would not be required.

In relation to this Option, it is important to note that it is highly likely any proposed mammal reintroductions in the Pilliga will fail in the absence of conservation fencing. This is explicitly recognised in the Saving our Species policy. Outside of south-western Australia, there have been no successful (established over the long term) mainland reintroductions of the relevant species in the absence of feral-proof fencing. There are several examples of failed attempts

to reintroduce the candidate mammal species in the absence of a fence (e.g. Western Quoll and Numbat: several locations in Western Australia; Western Barred Bandicoot: Heirisson Prong WA; Brush-tailed Bettong: Francois Peron National Park WA; Yathong Nature Reserve, NSW and several locations in Western Australia and South Australia; Bridled Nailtail Wallaby: Idalia National Park, Qld) or where a fence has proven ineffective, for example due to poor maintenance (e.g., Bilby, Currawinya National Park, Queensland). The major factor driving the failure of mammalian reintroductions in Australia is the presence of feral cats and foxes (Woinarski et al., 2014).

Advantages

- Lower initial capital expense as the fence would not be constructed.
- No negative impacts to native vegetation and habitat as a result of fencing/infrastructure establishment.
- Users of the SCA can still access the entire EMA project area without the restrictions that would apply in relation to the 5,800 ha fenced area.
- Potentially some scientific learnings if the fate of the reintroduced mammals is tracked in a rigorous manner.
- Limited economic benefits for the region (significantly less than Option 3 given the reduction in capital investment and the elimination of long term visitor opportunities linked to reintroduced mammals).
- Potentially some government/community/stakeholder support for the proposal would be realised. However, this will be compromised by the likely failure of the reintroductions.

Disadvantages

- As indicated above, it is highly likely the mammal reintroductions will fail.
- Poor use of financial resources as there will be no ecological return on the investment – i.e., it will be largely wasted.
- Lost opportunity for significant economic benefit for the region.
- NSW Government commitment to Saving our Species policy not delivered and the terms of the EMA not implemented.

4.1.3 Option 3: Reintroduce extinct mammals with conservation fencing and associated infrastructure

Option 3 fulfils the agreement made between the NSW Government and AWC to deliver the Extinct Mammal Agreement ("A project to reintroduce locally extinct mammals", Agreement number: OEH-677-2014). It requires the construction of a conservation fence to exclude feral predators, the removal of feral predators and herbivores from inside the fence, and subsequent effective maintenance of the fence. In turn, these actions require the development of a nearby operations base and a new management trail inside the fenced area. The proposed sites for the fence, operations base and new trail are the result of considering ways in which advantages could be optimised and disadvantages minimised. Factors influencing site and design selections are described in detail in Section 4.3.1.

Advantages of Option 3

- High likelihood of success in reintroducing mammal species which are listed as extinct in NSW and for which predation by foxes and feral cats is the most significant threatening process. The effectiveness of conservation fencing has been recognized in the Mammal Action Plan (Woinarski et al., 2014), in the Australian Government's

Threatened Species Strategy (www.environment.gov.au/biodiversity/threatened/publications/threatened-species-strategy) and in a report of a recent Federal Senate inquiry (www.aph.gov.au/ParliamentaryBusiness/Committee/Senate/EnvironmentandCommunications/Completedinquiries/2010-13/threatenedspecies/report/index). AWC has successfully delivered conservation fencing and associated reintroductions of threatened mammals at Scotia Wildlife Sanctuary, Karakamia Wildlife Sanctuary, Yookamurra Wildlife Sanctuary and Mt Gibson Wildlife Sanctuary.

- Substantial increase in the population of at least six threatened mammal species, currently listed as extinct in NSW (Table 1).
- Substantial benefits for other species, including many species listed as threatened in NSW, as a result of the removal of feral animals including, but not limited to, Eastern Pygmy-possum, Koala, Black-striped Wallaby and Pilliga Mouse.
- Significant increase in scientific knowledge as a result of the proposal.
- Restoration of ecosystem processes such as digging/turnover of soil by small mammals.
- Key significant government/community/stakeholder support for the proposal would be realised.
- Opportunity for significant economic benefit for the region through the capital investment in establishment of the proposal, the ongoing investment in delivery of the proposal and the establishment of an additional visitor attraction in the region.
- Opportunity for increased park visitation.

Disadvantages

- Higher capital expense than Options 1 or 2. This needs to be considered in the light of the substantial ecological return generated by that investment.
- There are limited negative impacts to native vegetation and habitat as a result of conservation fencing and associated infrastructure construction. However, these do not represent a significant impact on the environment.
- There will be changes to the environment resulting from reintroduction of mammals, which potentially include a reduced abundance of particular plants or animals eaten by reintroduced mammals, but such changes are part of the restoration of the ecological processes that operated at the proposal site in the past, prior to the introduction of feral predators and herbivores. The activities of native mammals do not represent a significant negative impact on the environment.
- Populations of native mammals reintroduced to a large fenced area may, over decades, require management, including genetic management and management of population size. Reintroduction to a fenced area therefore requires robust monitoring and potentially more intensive management than other options less likely to result in successful reintroduction of threatened mammals.
- Access to the fenced area by users of the SCA will be regulated instead of access being unrestricted.

4.1.4 Preferred option

After careful analysis of each option, the OEH, as the proponent, has determined that the preferred option is Option 3. It delivers a significant environmental benefit through the reintroduction of regionally extinct mammals. It also delivers other substantial benefits to the local community. It gives effect to a commitment under the NSW Governments Saving our Species policy and the Extinct Mammal Agreement as detailed in Agreement Number OEH-677-2014: A project to reintroduce locally extinct mammals.

Option 3 meets the objectives of the proposal and will not have a significant impact on the environment.

For the purpose of this REF, Option 3 is the preferred option for the proposal.

4.2 OBJECTIVES OF THE PROPOSAL

The NSW Government and AWC have signed the Extinct Mammal Agreement under which AWC is required to deliver the project. The Extinct Mammal Agreement ("A project to reintroduce locally extinct mammals", Agreement number: OEH-677-2014) gives effect to a commitment under the NSW Government's *Saving our Species* policy.

The *Saving our Species* program aims to maximise the number of threatened species that can be secured in the wild for 100 years (see Section 2.2.3).

The objective for this proposal as set out in the EMA is:

> To maximise biodiversity outcomes in each of the Parks and increase community engagement with threatened species through the successful reintroduction of mammals formerly extinct in NSW and associated management activities.

In the Initial Period of 10 years commencing 1 May 2016, the following desired outcomes are identified to help meet the objective:

1. Viable populations of reintroduced mammals are established inside the fenced area, or are on track to becoming established, and progress has been made towards enabling establishment of populations of reintroduced mammals outside the fenced area.
2. Successful reintroduction of locally extinct mammals is leading to improved ecosystem health within the fenced area.
3. Reintroduction of locally extinct mammals leads to community engagement in threatened species and park management, and increased social benefit.
4. Increased knowledge leads to improved conservation outcomes.
5. Delivery of agreed park management services meets Government and public expectations.

4.3 DESCRIPTION OF PROPOSAL

The proposal comprises the following:

- The construction of a 32.1 km feral predator-proof fence enclosing an area of 5,822 ha in the Pilliga SCA. The conservation fence would require a 12-15 m wide management trail to be cleared (6-7.5 m wide on each side of the fence), resulting in the removal of up to 48 ha of native vegetation. AWC typically clears a line 10-11 m wide for conservation fences. The tall forests in the Pilliga pose a risk to the fence through falling branches and trees. By increasing the width of the fenceline clearing, the risk of branches is reduced, and the damage any fallen trees cause can be limited by regular patrols and identification of trees that may be at risk of falling. AWC is applying the same methodology to another fencing project in Western Australia, also being constructed in tall forests. No internal fences will be constructed within the fenced area other than temporary fencing, if required, to facilitate the effective release of particular species as determined by the Translocation Proposal (e.g., a temporary holding pen). Any such temporary fencing would be installed and removed without material impact on the environment.
- Management of the fenced area including the removal of feral animals.

- The reintroduction of at least six threatened mammal species: Bilby, Western Barred Bandicoot, Bridled Nailtail Wallaby, Brush-tailed Bettong, Plains Mouse and Western Quoll.
- The establishment of an associated operations base (housing, infrastructure, services, etc.) in the Pilliga SCA, with a footprint including the Asset Protection Zone (APZ) of about 11 ha (vegetation to be partially removed and completely modified) outside the feral-free area. Core elements of the operations base are set out in Appendix 4 and in Section 4.3.3 below. Users of the operations base will include representatives of AWC and NPWS, including our partners who are engaged in project delivery. Examples include resident AWC staff; visiting AWC staff; NSW Government staff; contractors; volunteers involved in activities such as bird surveys; external researchers such as university students and, from time to time, guests involved in promoting awareness and outreach (e.g. representatives of media, Federal and local government, local community organisations, representatives of other conservation projects and participants in the philanthropic sector relevant to conservation). The operations base will not be used for tourism or general visitation by the public. Facilities for visitors, including the development of a campground will be proposed following the reintroduction of native species. Key elements of the operations base include:
    - living quarters:
        - 3-bedroom house for the Operations Manager
        - 2-bedroom house for the Wildlife Ecologist
        - 4 self-contained cabins for Field Ecologists and Land Management Officers
        - block accommodation with 8 single rooms for visiting personnel;
        - communal living area (including kitchen and laundry); and
        - communal ablutions block.
    - workplace facilities:
        - office for up to 8 people
        - private bushfire shelter
        - large workshop
        - power system with solar, batteries and 20 kVA diesel generator
        - rainwater storage
        - chemical and general storage.
- Establishment of a new management trail about 8.2 km long; about 3.3 ha of vegetation would be removed.
- The total impact area for this proposal is approximately 62 ha.

A summary of the proposal features is in Table 5.

Table 5: Summary of proposal and description

Item	Description
Feral predator-proof fence	32.1 km in length, and 1,800 mm tall. About 48.2 ha of native vegetation would be removed.
Operations base	Housing, infrastructure, office, services. Details of these are provided in Appendix 4 and Section 4.3.3 below. About 11 ha of vegetation would be removed or modified to create an Asset Protection Zone (APZ).

Management trail	8.2 km in length, about 4 m wide. About 3.3 ha of native vegetation would be removed.

4.3.1 Justification of the fence, operations base and new management trail locations

The EMA project requires the reintroduction of mammals into a feral predator-free fenced area. For the fenced area to remain feral predator-free, it is essential that the fence is patrolled frequently (every 2-3 days) and for any damage to be repaired rapidly. This intense inspection regime makes a nearby operations base a necessity.

AWC have carried out extensive analysis of the potential locations of the conservation fence, the new management trail and the operations base. Avoiding or mitigating adverse impacts influenced site selections. The current proposed location of the conservation fence has been determined after consideration of the following factors.

- Land tenure: the proposed fence is not able to follow the existing road (Railway Survey Road) because the road is on land owned by Forests NSW. Accordingly, it is offset by about 120 m away from existing road clearing and the SCA boundary. The proposal to offset the road was supported at a site meeting with local NPWS staff on the basis that it was also necessary to minimise risks to the integrity of the fence that might arise in the context of public road traffic alongside the fence.
- Distribution and extent of vegetation communities (the fenced area has been placed to encompass a wide variety of vegetation communities to meet the ecological needs of the reintroduced mammals, given the constraints on fence location – notably, drainage lines, wetlands and roads). The proposed fenced area contains 10 vegetation types (based on Plant Community Types (PCTs) – these are described in Section 5.8.4.1 and areas of each type within the proposed fence are listed and shown in Table 6 and Figure 25). A precautionary approach suggests a diverse mix of habitats will optimise the likelihood of successful establishment of the Pilliga reintroduction species. The mammals to be reintroduced to the Pilliga are expected to have a range of habitat preferences (see Section 4.4), although definitive habitat preferences in the proposed fenced area are unknown, due to the long absence of all species from NSW.
- Threatened ecological communities (the fence, new trail and operations base have been sited to avoid listed communities).
- Existing road and firetrail network (fenced area has been sited so as not to restrict access on important roads and firetrails; maintenance of access to required firetrail standard is also the reason why the fence is offset from Bens Road).
- Watercourses (the fence has been sited to limit impacts on waterways).
- Avoidance of Aboriginal and other cultural sites.
- Size: the fence location addresses the above issues/constraints while being of sufficient size to support viable populations of reintroduced species (see Table 1).
- Area to perimeter ratio to minimise clearing for the fence: While a circular fenced area would have the shortest perimeter, it would be impracticable in terms of the existing road network and would also compromise the structural strength of the fence. Various options were assessed before the proposed location was selected: for instance, square or rectangular designs would not fit well with the existing road network, and would have required more clearing for new access trails. The proposed design makes use of existing roads for access to gates.

The three principal considerations, ecologically, that went into selecting the proposed location of the operations base were:

1. that the footprint should be located primarily on the most common and widespread vegetation type in the park (i.e. Buloke-White Cypress Pine woodland);
2. that the footprint should be located predominantly in an area that had been previously disturbed;
3. that the footprint should be located outside of a 50 m creek buffer to protect the more sensitive riparian zone vegetation community that consists largely of red gums and Rough-barked Apple (PCT 399, see Section 5.8.4.1 for more detail).

Additional considerations are listed below.

- It is essential to the ongoing success of the project that the operations base is near the fenced area. The fence will be patrolled every 2-3 days to ensure there is a rapid response in the event of any damage to the fence. In the Pilliga, the risk of trees and branches impacting the fence is considered to be high. Other projects have seen a significant loss of native species where the fence has not been patrolled or maintained adequately (for example, Currawinya NP, QLD).
- Locating the base on Harris Road within the SCA ensures the security of tenure. Purchasing or leasing nearby farmland is not a viable option because of the cost involved; the uncertainty around tenure (assuming a lease, sublease or covenant was attempted); and the requirement for the base to be as close as possible to the feral proof fence.
- The current site on Harris Road was selected, following consultation with NPWS staff, on the basis of providing ready access to the fenced area, avoiding locations subject to flood risk, aesthetics for liveability, providing at least three exit routes in the event of a critical incident (such as bushfire), whilst ensuring that the facilities were located off a major public-use road thereby assisting with security and dust impact on staff and buildings.
- The scale of the operations base has been determined on the basis of mitigating risk as far as is practicable for bushfire threat by ensuring that buildings have enough distance between them to limit the risk of fire transferring from one building to another. In addition, providing space between accommodation buildings, the accommodation precinct and the operational areas such as the office and workshop ensures that noise impact will be minimised and privacy not compromised.
- The proposed site is offset from Harris Road to minimise the visual impact for any passing traffic.

Further information regarding the operations base location and development is provided in Appendix 4.

4.3.2 Construction of the fence

The conservation fence is a specially designed fence that will prevent incursion of feral animals to the enclosure. The proposed fence is a continued evolution of that constructed at AWC sanctuaries, and specifically based on that successfully implemented at Mt Gibson Wildlife Sanctuary in Western Australia. Early versions of the fence were subject to breakages through impact by macropods. As such, top two sections of netting that would be installed on the fence will overlap (as opposed to being 'butt-joined') to improve the strength across the join (see diagram in Appendix 4). There would be a second overlapping section extending up from the base (the area most subject to macropod impact).

The fence would be 1.8 m high, with a floppy top and two hot (electric) wires. In addition, the fence has two 'skirts' that lay flat on the ground on the inside and outside of the fence, extending 450 mm and 300 mm respectively. The bulk of the fence is constructed from netting, with 30 mm aperture on the lower section and 40 mm on the upper section. The smaller holes on the lower section are designed to prevent small rabbits entering the fenced area (see diagram in Appendix 4).

Up to eight gates will be included at strategic points (such as existing firetrails) to provide people within the fenced area an equidistance to the nearest exit point for emergency management (such as wildfires).

Upon completion of the fenceline clearing, strainer assemblies will be installed wherever the alignment changes. Once the strainers have been installed (consisting of posts and rails – designed to provide a point to tension wire from), a single plain wire will be installed at ground level as a 'sighter wire'. This provides a sight line for the installation of pickets and intermediate posts.

Intermediate posts (posts 1,800 mm above ground level (AGL), 80 mm nominal bore) will be spaced approximately every 400-500 m, or where extra strength or support is required. Intermediate posts will be concreted into the ground.

Pickets (1,800 mm AGL) will be spaced every five metres. Pickets will be installed mechanically, using a post knocker that will ram them to a depth of 600 mm. Following installation of posts and pickets, 6 horizontal plain support wires (2.5 mm diameter) will be strung, spanning the height of the fence (making a total of 7 horizontal plain wires, including the sighter wire). The plain wires will be tensioned back to the strainers, and tied off to the pickets using tie-wire.

Hot wire 'stand-offs' will then be installed. The stand-offs are 160 mm long rods that support the electric wires, and keep them clear from the body of the fence to prevent shorting out. The stand-offs will be bolted to the pickets at approximately 1,000 mm and 1,300 mm AGL. Insulators will be fitted later in the construction process.

Netting will then be installed. Three rolls of netting are used:

- 1,800 mm wide roll for the upper vertical section, including the 600 mm floppy top (40 mm aperture);
- 1,200 mm wide roll for the lower vertical section and external skirt (30 mm aperture);
- 900 mm wide roll for the lower section and internal skirt (30 mm aperture).

All netting will be 1.4 mm gauge.

Netting is connected to the plain support wires using 'c-clips' that are installed using pneumatic guns. At this point, the floppy top will have lengths of 3.15 mm plain wire threaded in the netting that forms the floppy top to help hold its shape so that it is effective in excluding any feral animals that climb the fence. These will be installed at every picket, and two between pickets.

Electric wires are then installed – threaded through insulators on the stand-offs – to be connected to a solar powered electric fence energiser. Two of these energisers will be installed at diagonally opposite sections of the fence to ensure consistent voltage is maintained around the perimeter.

The final item for installation will be gates; the proposed gates are sliding gates that will roll on tracks set into a concrete plinth. The gates will have a fixed angle top to prevent feral incursions. All gates will be padlocked (keyed alike).

There will be minor variations in the fence design throughout construction to accommodate local variances in terrain (such as distance between posts and pickets).

A design for the fence as well as a modification for where the fence crosses ephemeral watercourses is provided in Appendix 4.

4.3.3 Establishment of an operations base (housing, infrastructure, services etc.)

The proposal includes the establishment of an operations base (housing, infrastructure, services etc.) in the Pilliga SCA to be constructed in accordance with the OEH Construction Assessment Procedures and the NPWS Park Facilities Manual and associated policies. Notably, building will primarily be modular construction (constructed offsite), and transported in and installed upon footings. All buildings will be externally clad in colourbond of blue and grey shades that will be sympathetic to the natural setting of the Pilliga forest. All buildings will be insulated, including floor insulation in visiting personnel accommodation.

Lighting within the operations base will consider the requirements of the Dark Sky planning guidelines (Department of Planning and Environment, June 2016). These guidelines have been developed to promote best practice outdoor lighting to protect observing conditions for the nearby Siding Spring Observatory, located on the edge of the Warrumbungle National Park.

The location of the operations base is shown in Figure 1 and the proposed layout of the components is shown in Figure 3. A description of the components is provided in Appendix 4. Key elements of the base include:

- living quarters:
    - a 3-bedroom house for the Operations Manager
    - a 2-bedroom house for the Wildlife Ecologist
    - 4 self-contained cabins for the Field Ecologists and Land Management Officers
    - block accommodation with 8 single rooms for visiting personnel;
    - communal living area (including kitchen and laundry); and
    - communal ablutions block.
- workplace facilities:
    - office for up to 8 people
    - private bushfire shelter
    - large workshop
    - power system with solar, batteries and 20 kVA diesel generator
    - rainwater storage
    - chemical and general storage.

All buildings will be constructed in accordance with the requirements specified in the Extinct Mammals Agreement: i.e., in accordance with relevant NPWS strategies (NPWS Construction Assessment Procedures, NPWS facilities manual), the Building Code of Australia, and the Dark Sky planning guidelines.

The footprint of the operations base is up to 11 ha, including a 75 m Asset Protection Zone (APZ). The operations base is located outside the feral predator-free area. The impacts to this 11 ha include:

- complete removal of vegetation from sites of buildings, water tanks and the like, and management trails;

- modification of vegetation in the Inner Protection Area, being a 50 m radius around the operations base:
    - 10% of the tree canopy will be retained; this will be a random sample of the trees present in this zone; and
    - shrub levels and ground cover will be reduced on the same basis and to the same extent;
- in the Outer Protection Area, being the outer 25 m radius of the APZ:
    - 30% of the tree canopy will be retained; this will also be a random sample of the trees present in this zone; and
    - shrub levels and groundcover will be reduced on the same basis and to the same extent.

The operations base will serve as both an accommodation base for AWC operational and science staff and visiting personnel, and provide the necessary office facilities to support the proposal and EMA project. In addition, a workshop area will be installed and legislatively-compliant chemical and hydrocarbon storage facilities established.

A private bushfire shelter will be installed to provide a place of refuge in the event of a significant wildfire incident that prevents staff within the base exiting to a safe area.

The operations base will be self-supporting utilising rainfall capture, solar power generation supplemented with diesel co-generation and gas energy consumption for water and accommodation heating as well as all cooking.

4.3.4 Eradication of feral predators and herbivores from fenced area

The eradication within the fenced areas will be delivered through intensive feral animal control programs informed by a comprehensive monitoring program. The feral animals known to be in the area are: cats; foxes, wild dogs, horses, cattle, goats, sheep, rabbits, hares, pigs and deer.

Phase 1

A monitoring program will be implemented – consisting of remote camera traps (up to 60 in number) deployed in an array throughout the fenced area, and sand plots on trails. Data logging of eradication effort will be conducted to track the activity of feral animals. These monitoring tools will be used to determine activity of feral animals, and thereby refine tactical deployment of resources in an efficient manner.

All feral animal control will be conducted in accordance with standard operating procedures (SOPs) as developed by the Invasive Animal CRC. Horses will be excluded from the proposed fenced area by non-lethal means. Fodder may be provided in strategic locations external to the fence to attract as many animals away from the fence as possible.

The initial program to be implemented will be control of rabbits. Rabbits are a food source for cats and foxes. Removal of this food source will ensure that feral predators are more likely to be interested in baits and attractants. Immediately prior to the fence closing, rabbit baiting will commence – using Pindone and/or 1080 treated oats and carrots. Rabbit haemorrhagic disease (and subsequent variations of rabbit biological control agents) will be utilised where conditions at the time of eradication permit. It is not anticipated that ripping of warrens will be an effective tool in the Pilliga environment – partly because of low density of warrens, but also because of poor access to warrens for a suitable machine. Should warren use be determined to be an issue in reducing rabbit numbers, methods including the use of Phostoxin will be applied. Control of rabbits will be conducted until the rabbit numbers are at ecologically insignificant numbers, where ecologically insignificant means that numbers are

so low that AWC believes their impacts are unlikely to be significant. AWC has developed a draft Ecological Health Monitoring Framework (EHMF, see Appendix 13) which will provide the means of measuring this.

Phase 2

Once the fence is at 'lock up' stage, intensive control of feral predators and herbivores will be conducted. The tactical deployment of eradication effort and tools will be modified in response to the information generated by the monitoring program. Typically, the eradication tools will include:

- ongoing regular spotlighting patrols: these patrols will be used for opportunistic shooting of feral herbivores (other than horses) and predators;
- deployment of soft-jaw traps;
- deployment of cage traps, using a variety of attractants to bring feral animals into the traps;
- deployment of Canid Pest Ejectors (CPEs) throughout the fenced area, using a variety of attractants;
- pending activity records of feral herbivores, water and fodder points may be established to attract the feral herbivores to allow a safer and more efficient removal (note: there are no water points currently within the proposed fenced area; temporary ones may be introduced if required for feral animal removal);
- traps –using 1080 treated grains or manufactured baits – will be deployed for feral pigs, pending numbers recorded through the activity monitoring
- use of cat trackers;
- deployment of 'Eradicat' (subject to permit approval);
- deployment of cat-detection dogs.

Shooting (opportunistic or planned) will be conducted under shoot plans approved by NPWS and carried out by authorised personnel. Feral animal control programs will be consistent with the NPWS Vertebrate Pest Control Manual, Invasive Animal CRC SOPs and OEH standard operating procedures.

Verification of feral predator-free status

The proposed fenced area will be monitored using remote camera arrays (at least 1 camera per 100 ha) and sand plots. Verification of feral predator-free status will be determined through assessing activity of feral animals over time. Where there has been no activity detected on camera or on sand plots for 2-3 months, an 'interim feral-free status' will be declared. To ensure all feral predators have been removed, intensive monitoring will continue for a further 2-3 months post 'interim feral-free status', after which the area will be declared 'feral predator-free'. Subject to the results of the monitoring, initial reintroductions may be conducted before the conclusion of the 4-6 month monitoring period, with released animals monitored intensively for survival.

Once declared feral-free, regular monitoring for the presence of feral predators and herbivores will continue inside the fence (using remote camera traps and sand plots on trails) to ensure any incursions are detected.

It should be noted that the objective in relation to rabbit control is to reduce rabbit numbers to ecologically insignificant levels that do not impede the reintroductions, i.e. the proposal does not require complete eradication of rabbits although that will be achieved if feasible.

4.3.5 Removal of large macropods and Emus from fenced area

Large macropods (Eastern Grey Kangaroo and Wallaroo) and Emus within the feral-free area are a potential risk to the fence. Macropods could also reduce the prospect of success for the reintroductions by impacting on vegetation (i.e. removing cover and/or food for reintroduced mammals). Accordingly, AWC will aim to remove large macropods and Emus from within the fenced area through non-lethal measures. Lethal measures will only be considered should populations over a threshold persist. It is estimated that the total number of macropods and Emus to be removed by non-lethal measures are as follows:

- Eastern Grey Kangaroo: about 100 individuals; and
- Wallaroo: about 25 individuals;
- Emus: probably less than 5.

Phase 1

Whilst not specifically targeted at the removal of macropods and Emus, the increase in the level of activity in the area during the fence building would also encourage some macropods and Emus to relocate.

Phase 2

Upon completion of the fence, traps (in the form of small compounds) would be established at the gates using water and fodder as attractants. The aim will be to draw the animals into a compound near a gate in the fence, then release the macropods outside the proposed feral predator-free fenced area. This method has proved successful at other feral predator-free fenced area projects delivered by AWC, such as Mt Gibson in Western Australia where macropods and Emus were removed from across 8,000 ha.

Phase 3

If any macropods remain in the fenced area after Phase 2 above, AWC will anaesthetise remaining animals by darting with non-lethal drugs. Anaesthetised animals will be relocated outside the fenced area.

Phase 4

AWC expects to remove all large macropods using non-lethal measures. However, if any remaining macropods cannot be removed using non-lethal measures, AWC will consider seeking a permit to remove remaining macropods under an 'Application to harm protected fauna in NSW: Section 121 Occupier's License (Commercial) 2017'. Any such activity will then be implemented in accordance with the '*National code of practice for the humane shooting of kangaroos and wallabies for non-commercial purposes*'. Should an 'Application to harm' permit not be granted, AWC will attempt to manage populations through the continued usage of non-lethal drugs and trapping using methods detailed above.

4.3.6 New managementtrail and maintenance of existing road network

A century of previous forest management activities within the Pilliga SCA has resulted in a substantial network of existing formed and minor roads within the proposed fenced area. In addition to the existing road network, which will require ongoing maintenance particularly for shrub incursion, a single additional minor management trail is required so that effective land management, fire management and science activities can be delivered within the proposed predator-free fenced area. The proposed management trail location is designed to divide the largest existing 'blocks' of vegetation into several smaller, more manageable 'blocks'.

The additional management trail would be between Broom Road in the west to Rocky Creek Mill Road in the east, approximately bisecting the area between Sandy Road to the north and Railway Survey Road to the south (Figure 4). This management trail will be about 8.2 km in length and will be constructed to firetrail standards. This will consist of graded management trail built to comply with NPWS firetrail standards that will allow access by Category 1, 7 and 9 fire vehicles, with a clearing of approximately 4 m, with spoon drains up to 3 m in length located at 500 m intervals. This additional management trail is designed to increase the effectiveness of predator eradication, ecological monitoring, fire management and general land management within the proposed fenced area.

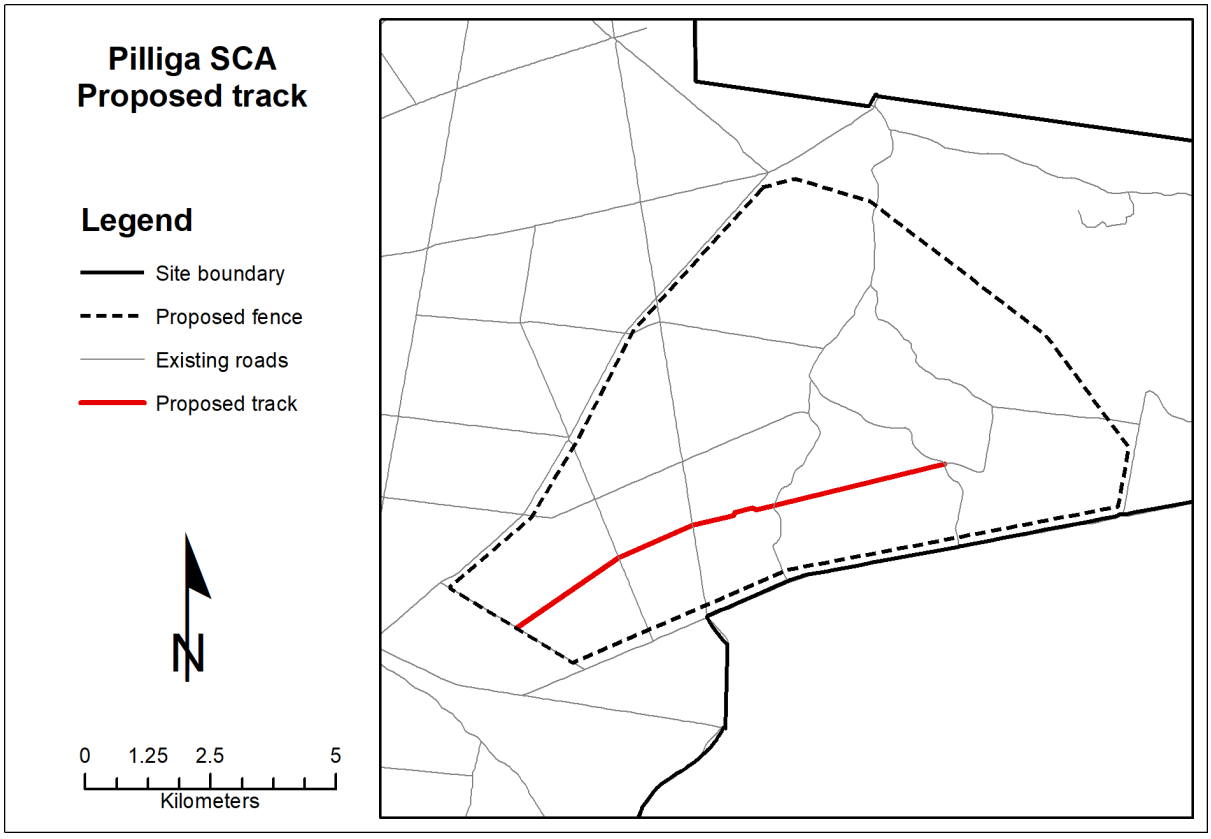


Figure 4**:** Location of a proposed management management trail within the proposed fenced area

4.3.7 Changes in feral predator control

AWC feral predator control priorities

The red fox (*Vulpes vulpes*) and feral cat (*Felis catus*) have contributed to declines and extinctions in a wide range of native fauna, and are the primary causes of decline in small and medium-sized ground-dwelling mammals, semi-arboreal mammals and ground nesting birds (Woinarski et al., 2014). Foxes and cats are now widespread across the continent and occur in the proposal area. The impacts of red foxes on native fauna can be reduced, to an extent, through coordinated and intensive control methods including, baiting, trapping and poisoning, although permanent eradication of foxes at a landscape scale is not possible. There are currently no effective measures for ongoing landscape control of feral cats.

The main priority for AWC predator control is to eradicate/reduce feral predators within the Pilliga SCA and NP (Gilgai section) (i.e. the EMA project area) with the dual purposes of:

- reducing predation pressures on the native fauna currently inhabiting the Pilliga EMA project area, and
- eliminating cats and foxes from the proposed fenced area prior to release of the reintroduced mammals.

AWC aims to do this through developing and implementing an integrated strategy for feral cat and fox control. The feral cat control strategy will be new (there is no existing feral cat control strategy) while the fox strategy will be a modified version of the fox strategy employed to date by NPWS. The strategy will include comprehensive monitoring programs to measure cat and fox activity (number of records per monitoring site) and occupancy (proportion of sites with records).

Plans for controlling other exotics such as pigs, goats and rabbits will be developed and implemented in parallel.

NPWS history of predator control in the project area

Information provided by NPWS indicates that fox baiting commenced sometime in 2006 after key 'at risk' species were identified. NPWS have two baiting runs in the EMA project area; one covering the northern section of the Pilliga ('Dog proof run') and one covering the south-western corner ('Cubbo') along the more frequented roads. There are no permanent baiting stations along these runs, with ground baits being buried in different locations each time, roughly 500-700 m apart. Baiting has been intermittent with no consistency with respect to month of the year, although it has usually been carried out in autumn and winter. A single use of poison ejectors has been recorded for August 2013. Surveys for fox and cat abundance in the Pilliga have never previously been conducted. As such it is not possible to determine if the NPWS baiting strategy has been effective in reducing fox numbers or if there has been any interaction between fox baiting and the population of feral cats.

Assessment of predator abundance

In late 2016, AWC conducted an initial survey to assess the baseline abundance of cats and foxes in the EMA project area.

Activity of cats and foxes (i.e. number of records per site) was assessed by an intensive camera trap survey. Motion cameras were deployed at each monitoring site (n = 50) and at the nearest point on a road (n = 50). Cameras were programmed to take three images per trigger, with a five-minute delay between triggers. Each camera was attached to a star picket or tree trunk at 50 cm above ground level; a sealed perforated lure tube containing a chicken neck was placed in front of the camera.

Results from the baseline survey indicated that, despite previous baiting efforts, the activity of both cats and foxes remains high throughout the EMA project area. Continued presence of predators is not unexpected as baiting success is only temporary and the highly mobile nature of foxes means that new animals will have migrated into the SCA and NP. However, as no previous surveys have been conducted, it is not possible to assess if any changes in population size have occurred post NPWS baiting.

AWC proposed predator control

The activity of cats and foxes throughout the Pilliga EMA project area indicates that the previous fox strategy needs to be modified and specific measures taken to target feral cats.

Red foxes

The previous NPWS baiting strategy has been reviewed in relation to the method of 1080 delivery, placement and spacing of baits, intensity of baiting and the seasonality of baiting.

Under AWC's revised strategy, the baiting runs through the Pilliga have been extended to include the perimeter of the EMA project area, additional roads along riparian zones (creek lines), and an intensive run that covers every road inside the proposed fenced area. This would create an intensively baited core area within the proposed fenced area.

Maintaining low fox populations throughout the entire Pilliga EMA project area would reduce immigration of new foxes into the core area and assist in maintaining an effective 'dispersal sink' (Thomson et al., 2000). This increased effort is crucial not only for the viability of the reintroduced mammals but for protecting the native fauna currently suffering from fox predation within the Pilliga.

In addition to an extended bait run, temporary ground baits would be replaced with permanent bait stations consisting of a combination of buried ground baits and CPEs (Canid Pest Ejectors). Foxes rapidly fill home ranges vacated in areas where control operations succeed in killing resident individuals (Newsome et al., 2014). CPEs have low rates of decomposition remaining in-situ for an extended period of time (Marks et al., 2017), ensuring consistent bait exposure throughout the year and reducing immigration after ground baiting events. Moreover, oral delivery with ejectors reduces the risk of non-target impact and eliminates translocation and caching of baits. More selective oral delivery assures a reduction in the number of non-target species exposed (Marks et al., 2017).

In addition to CPEs, ground baiting would be used to intensify the control effort during times of seasonal fox increases. As such, ground baiting stations will be deployed during autumn when juveniles disperse (Thomson et al., 2000) and spring when vixens increase foraging efforts (Towerton et al., 2016). To reduce the risk to non-target species, ground baits will be buried below ground level. Research has shown that burying baits underground with no dirt mound above reduces bait take by non-target animals (Glen and Dickman, 2003). Star pickets with colour-coded, numbered cattle tags will indicate the location of both types of bait stations.

All 1080 baiting would be undertaken in accordance with the requirements of the relevant Pesticide Control Order (Pesticide Control (1080 Ejector Capsules) Order 2015 and/or Pesticide Control (1080 Bait Products) Order 2017). Baiting strategies will be designed in accordance with the current Vertebrate Pest Control Manual and will take into consideration risk management for non-target species and OEH standard operating procedures.

The proposed bait stations are identified on Figure 5; no station will be within 500 m of the operations base. Actual use of bait stations will be subject to feral predator activity and results of monitoring. Those inside the fenced area will not be used once it is feral predator-free.

In addition to deploying CPE's, traps (soft jaw and cage traps) would also be utilised. AWC would also use planned shooting programs and opportunistic shooting to control foxes.

Feral cats

AWC would implement feral cat control using a combination of planned shooting programs, opportunistic shooting and trapping.

Results from baseline surveys indicated a larger number of cats recorded on road-based cameras than grid point sites located away from roads. Accordingly, trapping will be conducted along the road network in the EMA project area. Folding wire cage traps and leg

hold traps would be placed along the roads 700 m apart and deployed biannually in autumn and spring for a two-week period with a variety of lures used. Traps would be checked daily within an hour of sunrise and trained staff or contractors will euthanise captured cats. Planned and opportunistic shooting would be conducted onsite by licensed employees.

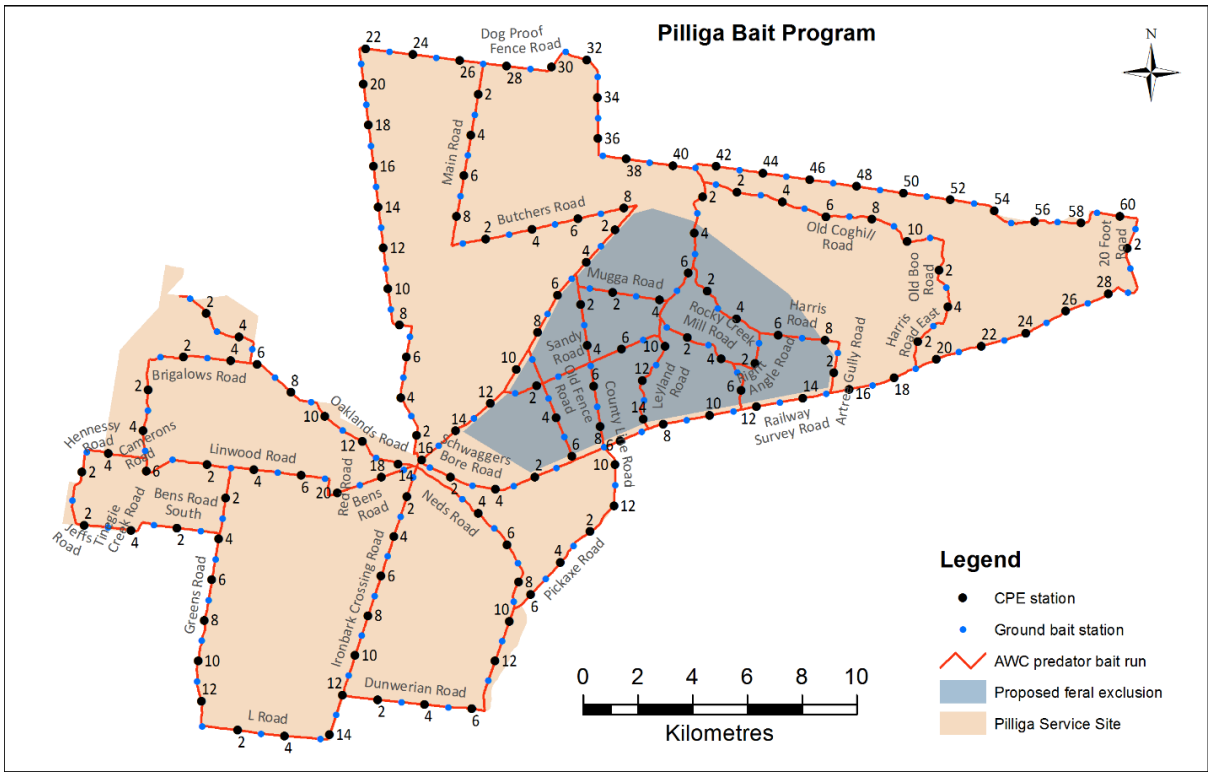


Figure 5: Map of proposed bait stations as part of the AWC baiting program.

4.3.8 Strategic fire management to protect infrastructure

The protection of life and property, including assets, is a legislative requirement and the primary fire management objective of the OEH. The OEH's asset protection obligations extend to all assets and activities on-park as well as off-park.

The OEH has a responsibility for assets owned by the OEH, or assets on land owned by the OEH and leased to a third party. The OEH also has a role in managing the risk to assets off-park if they are threatened by fire emanating from a park.

The OEH has overall responsibility for the delivery of fire management across the Pilliga EMA project area. AWC has a role in assisting in the design and delivery of fire management. Fire management will accord with the NPWS Fire Management Manual.

To reduce the risk of wildfire to protect infrastructure, AWC propose that a range of fuel management approaches be implemented using both prescribed burning and mechanical fuel alteration within three identified fire zone types.

- AWC propose the establishment of a long-term75 m APZ around the operations base to reduce fuel loads and thus minimise fire risk to the people stationed there.
- To reduce the risk of fire to the integrity of the predator-proof fence, AWC propose a 200 m Strategic Fire Advantage Zone (SFAZ) around the fence perimeter.
- To minimise the potential impacts of wildfire on introduced fauna within the fence, we propose 4 Land Management Zone (LMZ) burns, three of which would be within the

fenced area. The prescribed burns would be carried out to interrupt fuel continuity and also to potentially create refuges from fire for the reintroduced mammals. These are outlined in Figure 6.

These fire management measures need to be considered in the context of broader regional fire management strategies implemented by OEH and other landholders, which collectively influence the level of bushfire risk across the Pilliga and the effectiveness of any site-based measures.

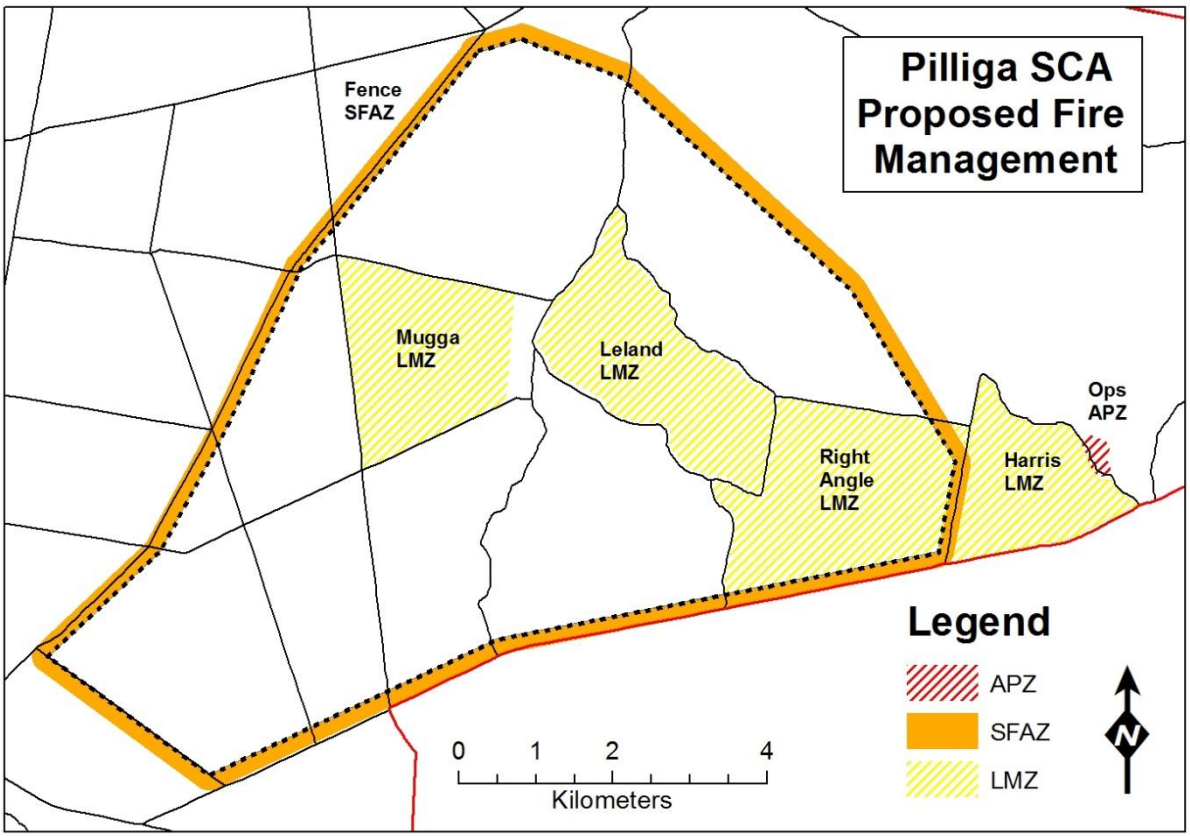


Figure 6: Locations of proposed hazard reduction burns around the proposed CFAI.

Asset Protection Zones

The primary purpose of an APZ is to protect life and built assets. The objectives of an APZ are to enable the safe use of direct attack suppression strategies within the zone and to minimise bushfire impacts on undefended assets.

It is proposed that a 75 m APZ be maintained around each building within the proposed operations base. This APZ will comprise an 'inner area' of 50 m (see the RFS document 'Planning for Bushfire Protection') and an 'outer area' of 25 m. These distances are consistent with those recommended in the RFS guidelines.

Fuel reduction within the APZ will be conducted by AWC using mechanical approaches with prescribed burns restricted to the outer area. The entire extent of the APZ will be managed to minimise surface fuel cover including reducing the cover of woody debris and shrubs. Canopy cover in the inner area will be maintained below 10% and in the outer area below 30%. Fuel loads will be managed on a yearly cycle.

Strategic Fire Advantage Zones

The purpose of a Strategic Fire Advantage Zone (SFAZ) is to provide strategic areas of fire protection advantage which will reduce the speed and intensity of bushfires and aid fire-fighting and containment efforts. In particular, SFAZs aid direct containment efforts during bushfires and also provide designated areas where indirect attack methods such as back-burning can be conducted. Fuel reduction within the SFAZ aims to reduce the risk of crown fire within the zone and to reduce the potential of spot-fire ignition from the zone. Reduction of fuels within the SFAZ can be achieved using both prescribed burning to reduce surface fuel loads and continuity, and the mechanical removal of ground debris, shrubs and sub-canopy trees to interrupt fuel continuity.

AWC propose the establishment of a SFAZ around the perimeter of the predator exclusion fence. This SFAZ will be 200 m in width. Within this SFAZ, fuel will be maintained at reduced levels. Fuel reduction burns will be conducted, under the management of OEH, within the SFAZ on a rotation consistent with the fire management strategy for Pilliga North with the aim of reducing surface fuel loads. Additional mechanical fuel treatments will be applied by AWC on shorter rotations to further disrupt ground fuel continuity. Canopy cover in the SFAZ may need to be reduced to achieve low crown connectivity.

Land Management Zones

OEH uses Land Management Zone (LMZ) burns to achieve objectives in areas where APZs and SFAZs are not appropriate. LMZ burns are frequently used to establish landscape fuel mosaics using longer-rotation burns. Within LMZs, fuel is reduced using prescribed fire, rather than mechanical treatments.

AWC propose the establishment of three LMZs within the predator-proof fence and a single LMZ outside the fence. Prescribed burning in these three LMZs may occur prior to construction, subject to OEH approval and resources. The objectives of these burns are to reduce fuel loads adjacent to the proposed operations base and to interrupt fuel continuity within the proposed fenced area. Together with recent hazard reduction burns, proposed burns and existing wildfire scars, the proposed LMZs will act as a landscape-scale fuel break to reduce the level of risk associated with fires originating in the south-east of the Pilliga. These burns are likely to also reduce the risk to sensitive wetland and riparian vegetation communities to the north in the Gilgai section of Pilliga NP.

4.3.9 Post-approval monitoring

AWC has developed a detailed draft Ecological Health Monitoring Framework (EHMF) for the Pilliga EMA project area (see Appendix 13). Under this draft EHMF, AWC ecologists will undertake regular biological surveys to measure a suite of indicators including:

- biodiversity indicators (species such as Koalas, etc.);
- threat indicators; and
- indicators related to ecological processes.

The objectives of this monitoring program include to: (a) track the ecological health of the Pilliga EMA project area over time; (b) monitor the success of endangered mammal reintroductions; and (c) measure the changes in ecological health that occur as a result of the removal of feral animals and the reintroduction of endangered mammals. The last will allow AWC to evaluate the outcomes of the reintroduction project for extant species and ecosystems at sites both inside and outside the fence.

The details of the draft EHMF may be modified once reviewed by the OEH, but the draft plans involve the most extensive and comprehensive long-term biodiversity monitoring program ever carried out in a NSW national park (a literature review has failed to identify any other biological monitoring program in a NSW NP that is as extensive and comprehensive). It will provide a scientifically rigorous mechanism for monitoring the impacts of the EMA project and identifying any adjustments to project delivery over time (i.e., adaptive management).

The total **annual** survey effort under the draft EHMF (Appendix 13), prior to the release of regionally extinct mammals, in the Pilliga EMA project area would be as follows:

- 1,920 pitfall trap nights: 60 sites, 8 traps per site, 4 nights;
- 4,800 box trap nights: 60 sites, 20 traps per site, 4 nights;
- 2,880 funnel trap nights: 60 sites, 12 traps per site, 4 nights;
- 960 cage trap nights: 60 sites, 4 traps per site, 4 nights;
- 3,360 camera trap nights: 120 sites (60 off-road, 60 on-road), 1 camera/site, 14 nights, repeated twice yearly;
- 150 bird surveys (standard 2 ha, 20 minute; and Songmeter) (50 sites, 3 replicates);
- 48 bat survey nights (Songmeter) (12 sites, 4 nights);
- 100 spotlight surveys (50 transects of 200 m, 2 repeats);
- 100 nocturnal bird/ mammal surveys (active listening and call playback; 50 sites, 2 repeats);
- 60 surveys of habitat and ecological processes;
- 30 vegetation surveys (15 inside fence, 15 outside fence); and
- other surveys including nest-boxes, targeted searches for frogs, threatened birds and plants, and potentially camera grids for estimating density of feral predators.

The level of effort will increase substantially to monitor survival, population dynamics and other metrics related to reintroduced mammals: these additional survey requirements will be identified as part of the translocation proposal process.

A 2.5 km grid overlain across the Pilliga SCA and Pilliga NP was selected as the primary approach to locating biodiversity monitoring sites as part of the draft EHMF. A grid at this scale was expected to provide spatial independence of survey sites for most of the wider-ranging species that are likely to be recorded in surveys. The grid was aligned with a Lamberts grid projection for New South Wales based on GDA 1994. The 2.5 km grid points were nested within a larger 5 km grid that forms the basis for biodiversity surveillance monitoring on adjacent State Forests undertaken by Forestry Corporation of NSW. This compatibility in approach provides a strong basis for comparison of conservation outcomes across a much broader landscape in the Pilliga (Figure 7).

The 2.5 km grid overlay resulted in 57 possible sites within the Pilliga SCA and Pilliga NP (Gilgai section), that is, within the EMA project area. Given the logistical constraints of the EMA project, the number of sites available for monitoring was reduced to a total of 50. AWC developed five hierarchical rules for removing sites, based on scientific and logistical concerns, while maintaining a randomised site-selection approach. In order of implementation, these were:

1. sites within vegetation types with <10% representation in the area were retained;
2. a minimum of 10 of the 5 km grid points were retained to ensure that there were sufficient sites for comparison with adjacent State Forests;
3. sites within 500 m of the edge of the EMA project area were removed;
4. sites at the greatest distance from the nearest road were removed;

5. when following these rules, any sites adjacent to those previously removed were retained, to ensure that site removal was not spatially biased within the EMA project area.

This process resulted in the removal of seven sites from the most common vegetation type in the EMA project area (Buloke-White Cypress Pine woodland), while retaining a representative sample of vegetation proportions within the project area across the selected 50 monitoring points (Figure 8).

To evaluate the outcomes of the reintroduction project for extant species and ecosystems, AWC will monitor biodiversity and threat indicators at sites located inside and outside the fence.

The same systematic approach to survey design used across the Pilliga EMA project area has been used to select monitoring sites inside the proposed fenced area. However, the 2.5 km grid used to select 50 sites across the Pilliga EMA project area resulted in only 10 grid points being located within the proposed conservation fence. To obtain sufficient data for robust evaluation of outcomes of the reintroduction project, and to collect rigorous information for species with relatively small home-ranges (e.g. reptiles and small mammals) an additional 10 monitoring sites are proposed inside the fenced area. Key challenges to establishing additional sites within the fenced area were achieving an appropriate level of sampling while maintaining adequate spatial separation between sites. We addressed these concerns in two ways, outlined below.

1. Use a grid to ensure spatial separation of sites.
2. Ensure that indicators were monitored at the appropriate scale to avoid pseudo-replication, as described below:
    a. Potential monitoring sites within the fenced area were located using a grid with a spacing of 1.25 km between points, nested within the existing 2.5 km grid (Figure 9). This exercise identified 27 additional sites within the fenced area, of which 17 points were removed due to proximity (< 500 m) to the proposed fence, and/ or over-representation of common vegetation types. The resulting total of 20 sites (10 sites on a 1.25 km grid, together with the 10 existing sites on the 2.5 km grid) should provide sufficient levels of replication to compare responses between vegetation types. The 20 sites are representative of vegetation assemblages across the Pilliga EMA project area. For the purpose of monitoring outcomes of the reintroduction project, the 20 sites inside the fence will be paired with 20 sites outside the fence, based on matching vegetation types.
    b. Indicators will be surveyed at an appropriate spatial scale. Animals with relatively small home ranges (small and medium-sized mammals and reptiles) and vegetation will be monitored at all 20 sites within the fence (i.e. on both the 1.25 km grid and the 2.5 km grid) and on all other 2.5 km grid sites outside of the fence. These taxa are expected to be the most responsive to any changes brought about by exclusion of feral predators and the reintroduction of regionally extinct species. Wider-ranging fauna such as birds, bats, macropods and invasive predators will be sampled at the 10 sites on the 2.5 km grid inside the fence, and on all other 2.5 km grid sites outside of the fence.

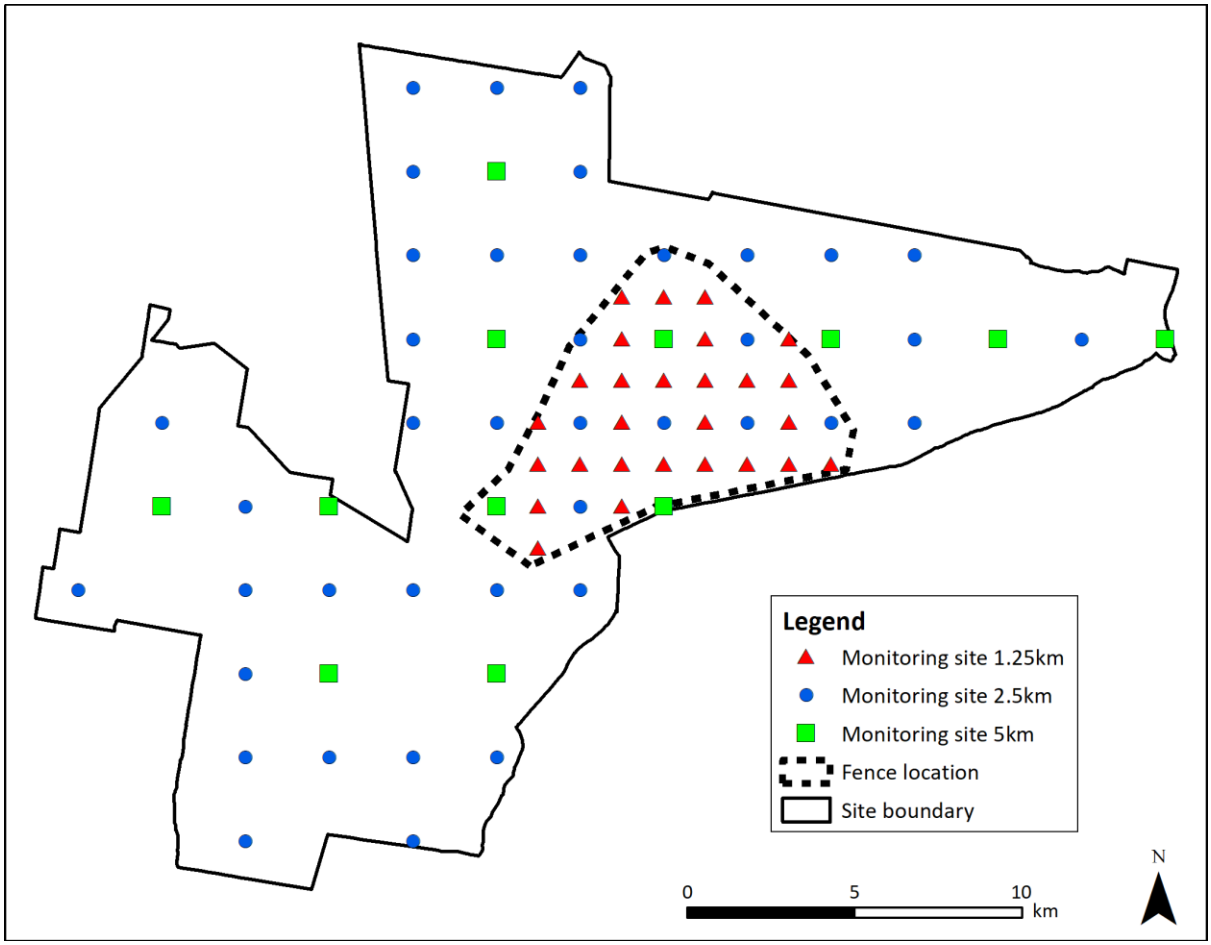


Figure 7: All potential monitoring site locations in the AWC Pilliga EMA project area, based on a nested grid design. Green squares represent an extension of the 5 km grid used by the biodiversity monitoring program within State Forests. The blue dots represent nested 2.5 km grid points. The red triangles represent nested 1.25 km grid points within the feral predator-free fence.

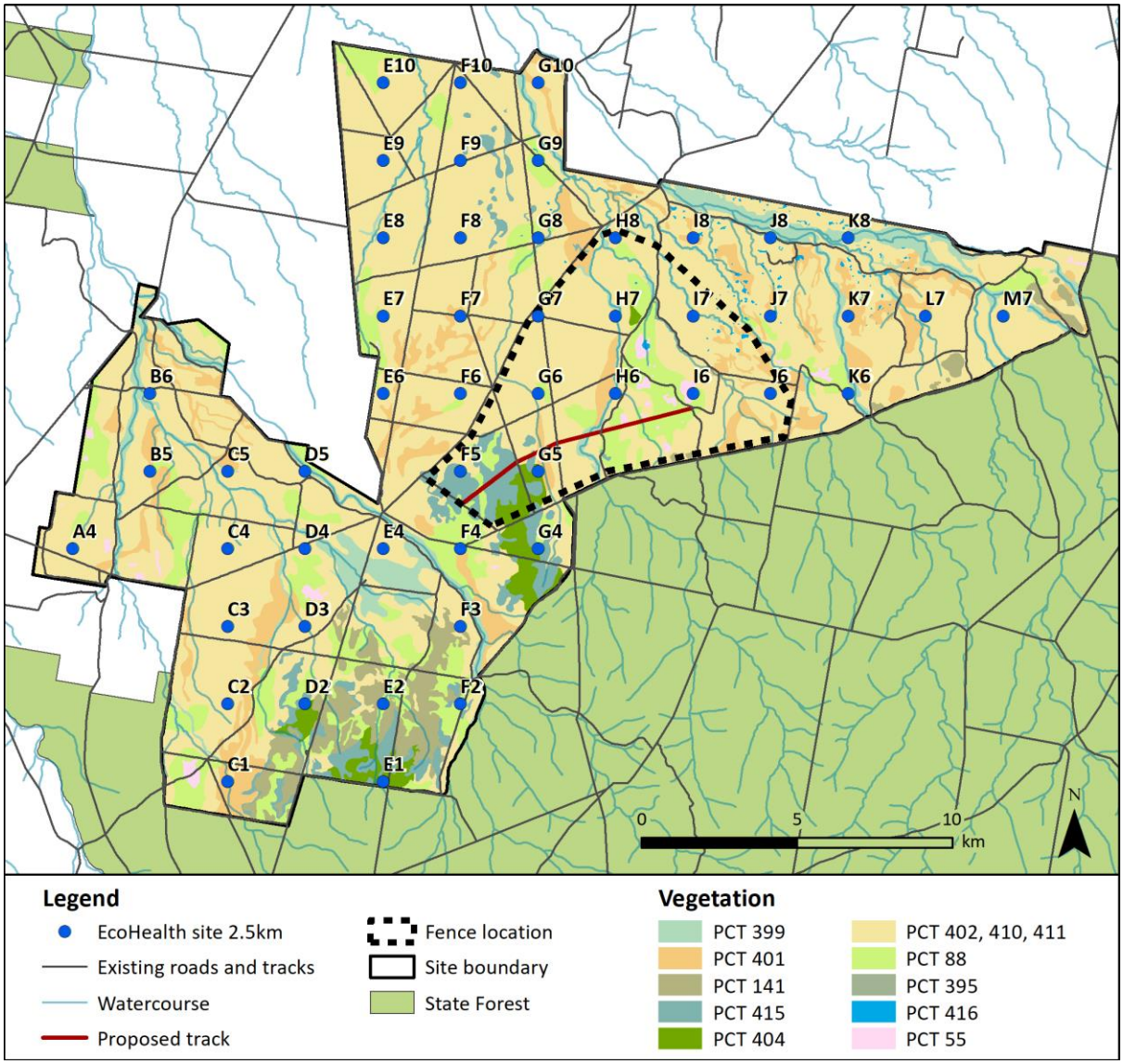


Figure 8: Location of 50 monitoring plots on a 2.5 km grid in the Pilliga EMA project area

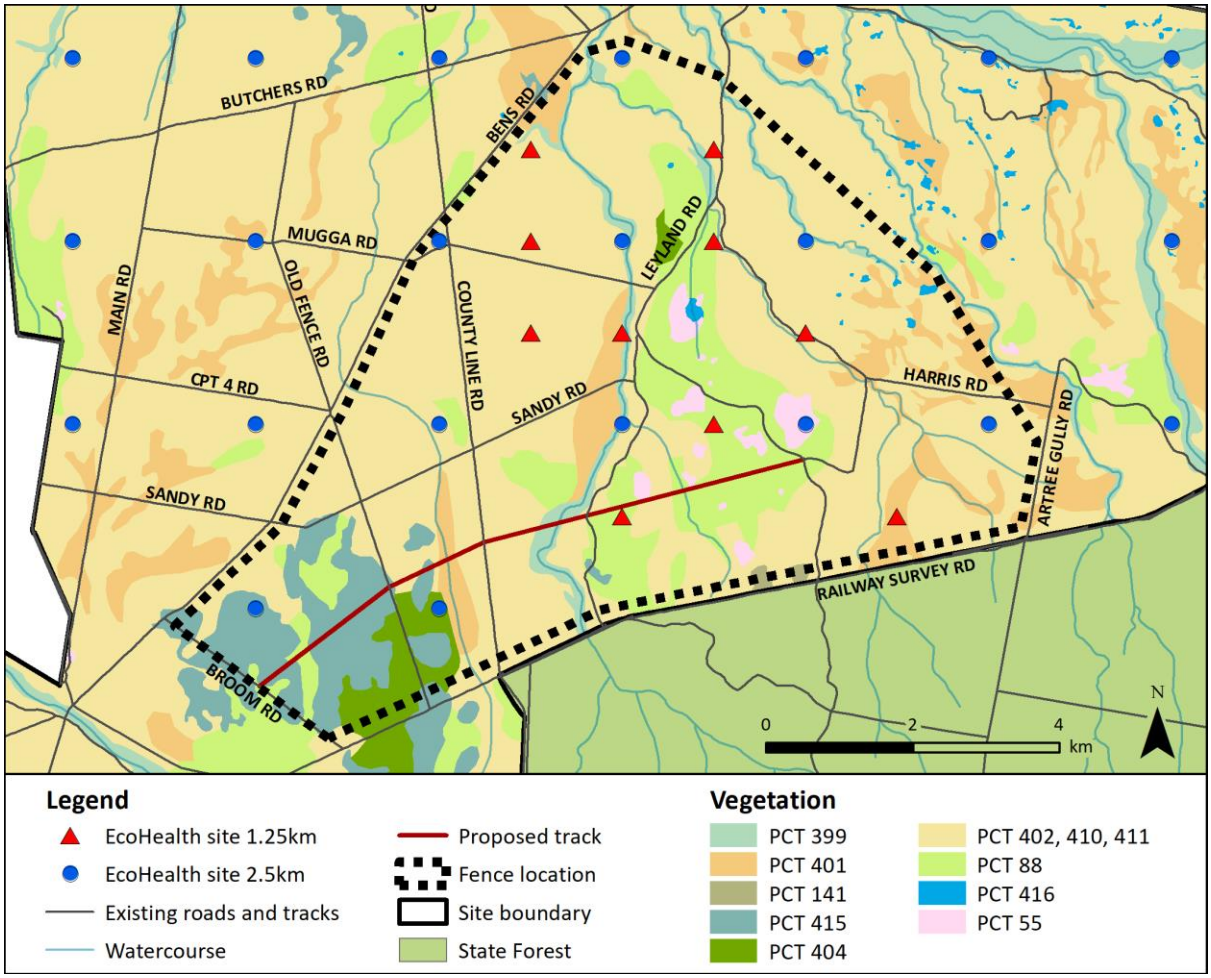


Figure 9: Distribution of monitoring sites in and adjacent to the proposed fenced area. The map shows monitoring sites on a 2.5 km grid (blue dots) and the additional 10 x 1.25 km sites (red triangles) which have been selected to increase the sampling effort for small mammals, reptiles and vegetation within the proposed fence.

4.4 REINTRODUCTION OF AT LEAST SIX THREATENED MAMMAL SPECIES

The reintroduction of at least five threatened mammal species will occur between March 2019 and April 2021. A sixth species, the Western Quoll, will be reintroduced at a time to be agreed by AWC and the NSW Government.

Detailed assessment and planning for these translocations will occur as part of the Translocation Proposal, as required under the Extinct Mammals Agreement. This REF will address the general impacts associated with reintroducing the threatened mammals (including impacts on resident species and vegetation).

The Translocation Proposal will require approval by OEH and would include the details of any licensing required for the reintroduction.

This section provides a summary of the mammals to be reintroduced as part of the proposal.

4.4.1 Western Quoll

Conservation status

NSW: Presumed Extinct; EPBC: Vulnerable.

Distribution

Pre-European: All of southern and central Australia, from WA through to the western slopes of the Great Dividing Range. Around 70% of the continent (Figure 10).

Current: remnant populations restricted to south-west WA. There is currently an attempt to reintroduce them to the Flinders Range, SA. Western Quoll persisted in central Australia to the mid 20th century (Burbidge et al., 1988). The last record from NSW was in1857.

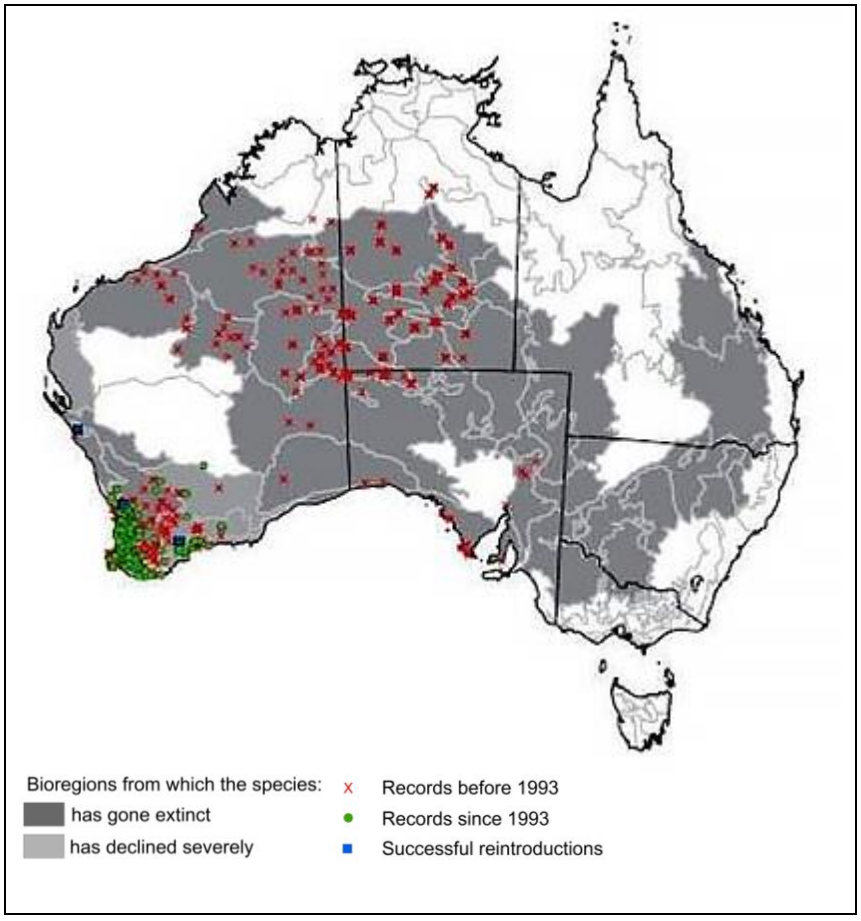


Figure 10: Western Quoll distribution (from Mammal Action Plan, Woinarski et al. 2014)

Ecology (overview)

- Size: 0.9-1.3 kg
- Diet: small vertebrates, invertebrates, carrion, fruit
- Breeding: annual, 2-6 young
- Average lifespan in wild: up to 3 years
- Nocturnal
- Terrestrial/arboreal
- Dens in hollow trees, rocky areas, burrows
- Mid-sized native predator, may help regulate populations of prey species.

Major threats (Mammal Action Plan)

- Foxes: severe, entire
- Cats: minor, entire (however, the Mammal Action Plan notes the actual impact of cats is unknown: cats have been significant predators of Western Quolls in the recent reintroduction to Flinders Range, SA)

Habitat preferences

Habitat generalist. At European settlement, the Western Quoll occupied a wide range of habitats from forests and woodlands to desert; its current distribution in WA includes 'most kinds of wooded habitat including eucalypt forest, dry woodland and mallee shrublands'. In south-west WA, before the implementation of broadscale fox baiting, the Western Quoll was mostly restricted to dense riparian vegetation; after fox baiting, the species has expanded into more open forest types. In central Australia, the Western Quoll occupied 'all types of country' (Burbidge et al., 1988, Parker, 1973, Finlayson, 1961).

Population density

In south-west WA, density varies with predator control (by up to an order of magnitude (Woinarski et al., 2014)) and with rainfall: reported densities range from 0.0004-0.007 individuals/hectare (Rayner et al. 2012), the lowest at low rainfall sites not subject to feral predator control. Densities in higher rainfall locations subject to predator control (but not exclusion) are reported to range from 0.003-0.007 individuals/ha. Female core home range reported as 90-200 ha, suggesting female density of 0.005-0.01/ha in locations where feral predators are controlled and habitat suitable. In the NT, quolls were reported to be 'plentiful' in the southern Tanami.

Reintroduction history

Six reintroductions of Western Quolls have been made to mainland sites in Western Australia, in conjunction with broadscale fox control. Three of these reintroductions are reported to have been successful. Since 2014, a reintroduction of Western Quolls to the Flinders Range, South Australia, has been attempted in conjunction with a program of intensive control of feral predators. Cats (mostly large male cats) have been responsible for most known mortalities.

Expected population size within fenced area

Predicted population size is challenging to estimate given large variation in density estimates, and the fact that WA populations are mostly in semi-arid environments. In the more mesic conditions experienced in the Pilliga, density is estimated to reach 0.015/ha, at which population size within a 5,800 ha enclosure would be around 90 animals. This estimate is likely conservative: the ecologically similar Eastern Quoll attains much higher densities in Tasmania (in places up to 0.4/ha).

Individual quolls may be able to disperse from the inside to outside the fence. However, given the large area inside the fence relative to quoll home ranges, it is expected that a population will remain within the fenced area. The species may build a population outside the fenced areas in conjunction with intensive feral predator control, such that the total population sizes will be larger than the fenced area alone. Population densities outside the fence, assuming intensive feral predator control, are predicted to be 0.007/ha at Pilliga, equivalent to 210 animals in 30,000 ha.

Prospects for release outside fenced area

Moderate-high chance of success, when coupled with intensive broadscale predator control. Populations have persisted at low densities on the mainland in south-west WA in the presence of cats and foxes. Following broadscale fox baiting, populations have increased in abundance and in the range of habitats used. Three of six translocation attempts to non-fenced areas in WA are reported to be successful to date. The recent reintroduction of quolls to the Flinders Range has suffered heavy losses to cats; it is too early to determine the success of that project.

AWC experience with species

The Western Quoll is resident on AWC's Paruna sanctuary, with one or two records from AWC's Karakamia and Mt Gibson sanctuaries, in south-west WA. AWC plans to reintroduce Western Quolls to Mt Gibson in conjunction with feral predator control.

Likely source populations

Captive bred animals (from Perth Zoo) were used to stock the three successful WA reintroductions. However, the recent reintroduction to SA was sourced mostly from wild populations in WA, supplemented by a few captive bred animals from Alice Springs Desert Park. AWC's reintroduction to Mt Gibson plans to source animals from wild populations in WA, providing sufficient numbers are available, supplemented with captive bred animals if required.

For this project, AWC intends to source Western Quolls from a number of wild populations in WA, supplemented with captive bred animals if required. The intention would be to maximise the genetic diversity of the reintroduced population.

4.4.2 Western Barred Bandicoot

Conservation status

NSW: Extinct; EPBC: *Parameles bougainville fasciata* Extinct; *P. b. bougainville* Endangered

Distribution

Pre-European: South-west WA, through SA to central western NSW and south-west Victoria (Figure 11).

Current: Bernier and Dorre Islands, WA; reintroduced populations on Faure Island WA, Arid Recovery (SA). Last record from NSW 1866.

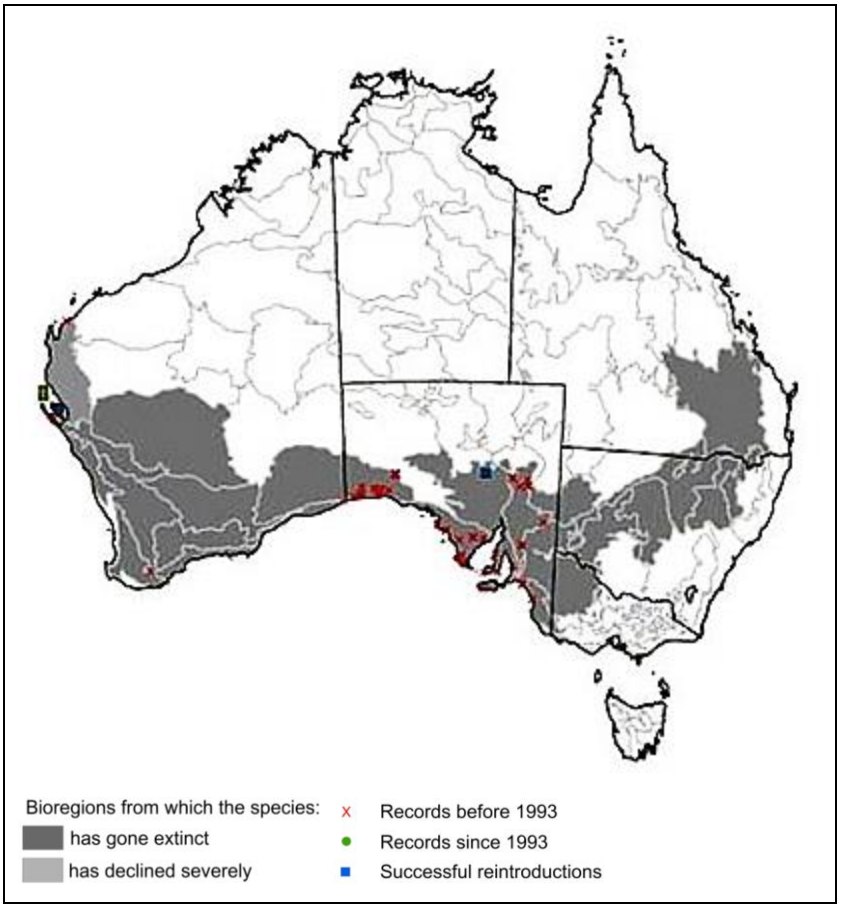


Figure 11: Western Barred Bandicoot distribution (Mammal Action Plan, Woinarski et al. 2014)

Ecology (overview)

- Size: 210-240 g
- Diet: omnivorous: invertebrates, very small vertebrates, fungi, tubers
- Breeding: winter months, 1-3 young, up to 4 litters a season
- Average lifespan in wild: 2-3 years
- Nocturnal
- Terrestrial
- Nests in shallow scrape beneath low shrubs

Major threats (Mammal Action Plan)

- Foxes: catastrophic, potentially entire.
- Cats: catastrophic, potentially entire.
- Climate change: severe, large.

Habitat preferences

Habitat generalist: occupied a wide variety of vegetation types in the southern arid and semi-arid zones including fairly open vegetation types (Richards, 2012).

Population density

Density on Bernier and Dorre Islands is reported to vary from 0.23-0.41/ha; population varies strongly with rainfall (six-fold: Short et al. 1997, 1998). Data provided in Woinarski et al.

(2014) indicate an order of magnitude variation in abundance with rainfall, and potentially very low abundance in drought years (c. 0.03/ha). Richards (2012) provides a density estimate of 0.18/ha, with substantial variation with rainfall (0.05-0.4/ha).

Reintroduction history

Western Barred Bandicoots have been introduced successfully to two predator-free locations: AWC's Faure Island in Shark Bay (WA) and Arid Recovery (SA). An introduction to a partly fenced mainland location in WA (Heirisson Prong) failed, presumably because of predation.

Expected population size within fenced area

In the relatively mesic conditions experienced in the Pilliga, density is estimated to reach 0.27/ha, at which predicted population size within a 5,800 ha enclosure would be 1,550 animals; variation with rainfall is likely to be of the order of +/-50%, that is, a range of about 800-2,250 animals.

Prospects for release outside fenced area

Reintroductions outside fenced areas have a very low chance of success unless both cats and foxes can be locally eradicated.

AWC experience with species

Western Barred Bandicoots were introduced to AWC's Faure Island wildlife sanctuary in 2005. This population has persisted, with population estimates of several hundred in recent years.

AWC plans to reintroduce Western Barred Bandicoots to a 7,800 ha fenced area at Mt Gibson in 2017.

Likely source populations

For this project, AWC intends to source Western Barred Bandicoots from wild populations in WA (Bernier and Dorre Islands), if possible, to maximise the genetic diversity of the reintroduced population. Additional sources include reintroduced populations on AWC's Faure Island, Mt Gibson and Arid Recovery (if available). Captive breeding may be used to increase the number of founders.

4.4.3 Bilby

Conservation status

NSW: Extinct; EPBC: Vulnerable.

Distribution

Pre-European: most of arid and semi-arid Australian mainland south of about 18^{o}S (Figure 12).

Current: Tanami, Gibson and Sandy Deserts, part of the Pilbara, south-west Queensland. Reintroduced populations at AWC's Scotia (NSW), Yookamurra (SA) and Mt Gibson (WA) sanctuaries, as well as Arid Recovery (SA), Thistle Island (SA) and Lorna Glen (WA). Last record from NSW 1912.

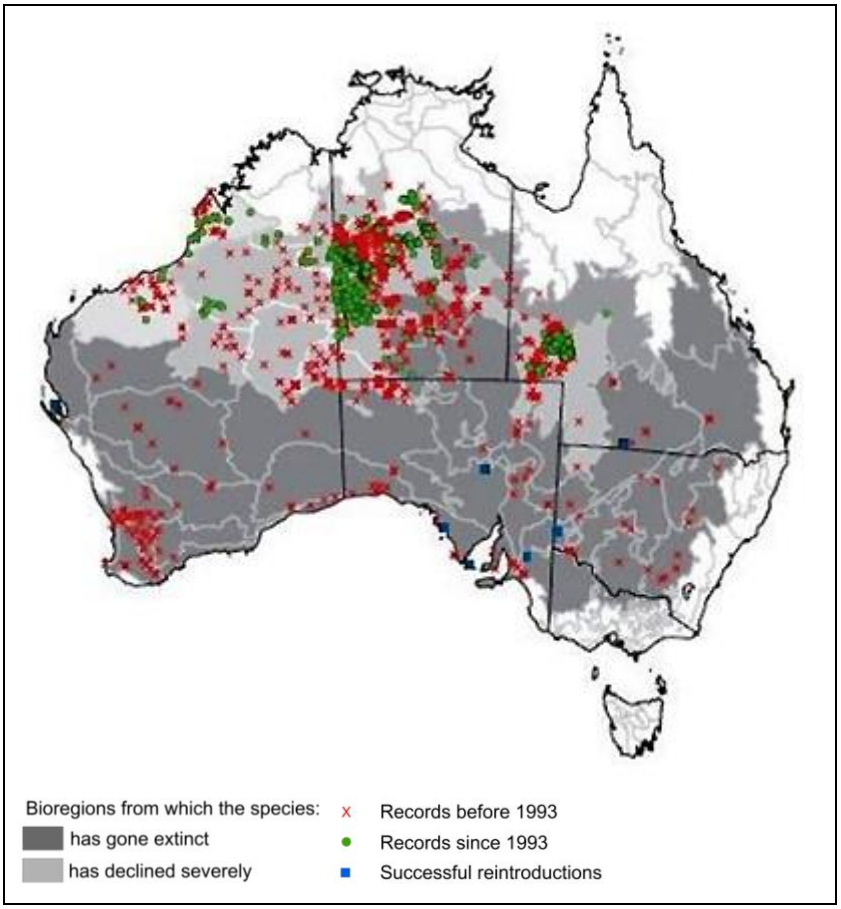


Figure 12: Bilby distribution (Mammal Action Plan, Woinarski et al. 2014)

Ecology (overview)

- Size: 0.8-2.5 kg
- Diet: omnivorous: invertebrates (primarily termites, beetles), tubers, forbs, fungi, fruit/ seed.
- Breeding: continuous given favourable conditions, 1-3 young
- Average lifespan in wild: 4-5 years
- Nocturnal
- Terrestrial
- Nests in deep burrows

Major threats (Mammal Action Plan)

- Foxes: catastrophic, almost entire.
- Cats: severe-catastrophic, entire.
- Inappropriate fire regimes: moderate, large.

Habitat preferences

Prior to European settlement, the Bilby was found in a wide range of habitats including eucalypt open forests and woodlands, shrublands and grasslands. Vegetation within current range described as “open tussock grasslands on uplands and hills, mulga woodland/ shrubland on ridges and rises, and hummock grassland in plains and alluvial areas.” In central Australia, the Bilby was “one of the most plentiful and universally distributed of

central Australian mammals" (Finlayson, 1961). Burbidge et al. (1988) have it in "all types of country except ranges". In the Tanami, according to Gibson (1986), the Bilby utilised "a wide variety of habitats but primarily open sandplain with regenerating forbs, grasses and shrubs".

Population density

Mean population density at AWC's Scotia and Yookamurra sanctuaries is 0.12/ha. Pavey (2006) states 0.12/ha as density in high quality habitat. Density on Thistle Island was estimated at 0.13/ha and 0.08/ha at Arid Recovery.

Reintroduction history

Bilbies have been successfully reintroduced to predator-free locations at AWC's Scotia (NSW), Yookamurra (SA) and Mt Gibson (WA) sanctuaries, and to Arid Recovery (SA), Thistle Island (SA) and Lorna Glen (WA). However, populations in several partly or inadequately fenced areas have collapsed due to incursions of feral predators: Currawinya (Qld), Venus Bay (SA) and Francois Peron NP (WA).

Expected population size within fenced area

Assuming a density of 0.15/ha (given the Pilliga is a more mesic location than most extant populations), population size within a 5,800 ha enclosure would be 850.

Prospects for release outside fenced area

Reintroductions outside fenced areas have a very low chance of success unless both cats and foxes can be locally eradicated or maintained at very low numbers, which is not currently feasible in an open landscape. Throughout its (unfenced) range, the Bilby is declining and occurs at low densities in isolated populations. Populations in south-west Queensland have continued to decline despite significant predator control. The population outside the fence at Lorna Glen (WA) is sparse.

AWC experience with species

Bilbies have been introduced successfully to AWC's Scotia (NSW), Yookamurra (SA) and Mt Gibson (WA) sanctuaries.

Likely source populations

AWC will aim to source Bilbies from wild populations (from one or more of populations in the NT, Qld and WA) to maximise the genetic diversity of the reintroduced population. Additional sources include reintroduced populations on AWC's Scotia, Yookamurra and Mt Gibson sanctuaries and possibly other reintroduced populations. Captive breeding may be used to increase the genetic diversity of founders.

4.4.4 Northern Hairy-nosed Wombat

Conservation status

NSW: Extinct; EPBC: Endangered.

Distribution

Pre-European: inland Queensland from the Burdekin River catchment to St George and Deniliquin in the Riverland, NSW (Figure 13).

Current: restricted to 500 ha of suitable habitat within Epping Forest National Park (Qld). Last record from NSW 1909.

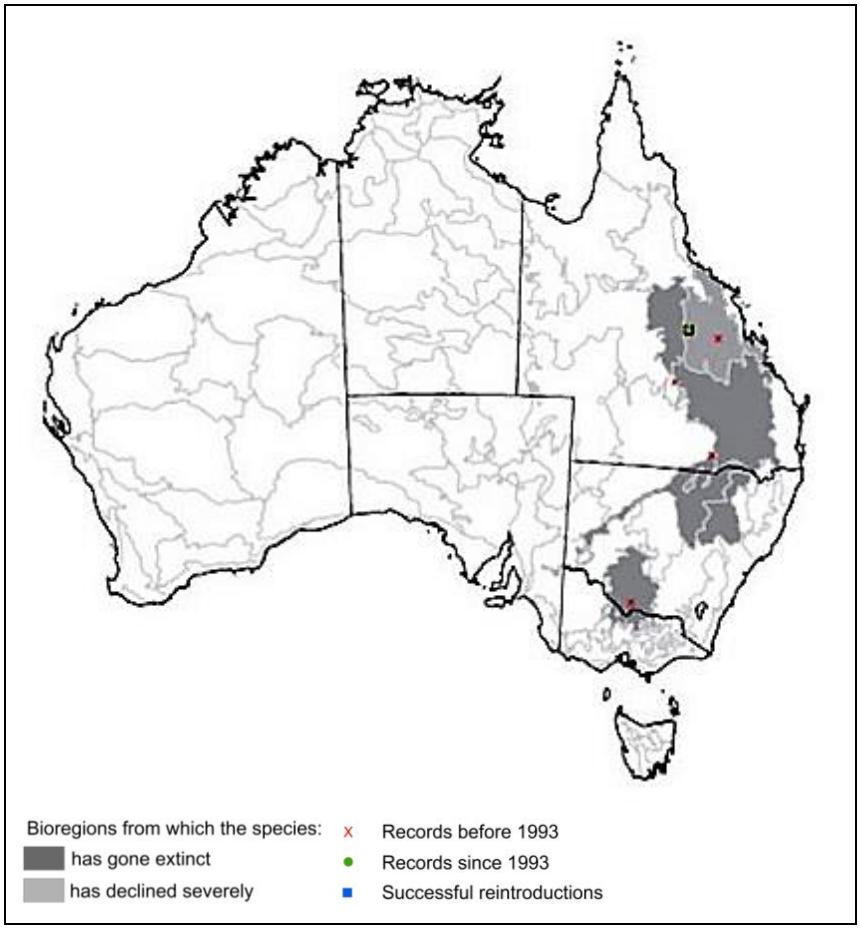


Figure 13: Northern Hairy-nosed Wombat distribution (Mammal Action Plan, Woinarski et al. 2014)

Ecology (overview)

- Size: 30-40 kg
- Diet: herbivore
- Breeding: once every two years during favourable condition, 1 young
- Average lifespan in wild: >20 years
- Nocturnal
- Terrestrial
- Dens in deep burrows

Major threats (Mammal Action Plan)

- Competition with cattle: formerly severe, but Epping NP has been fenced to exclude cattle.
- Dogs: was moderate, but Epping NP has been fenced to exclude dogs.
- Habitat degradation (weed invasion): severe, large (in Epping NP).
- Habitat loss: historically important, leading to fragmentation of populations.

Habitat preferences

Remnant population at Epping NP inhabits mixed eucalypt woodland with a grassy understorey on deep sandy soils; dominant vegetation in the park is Brigalow-Gidgee (*Acacia harpophylla-A. cambadgei*) scrub. The combination of soil suitable for constructing burrows and grassy ground cover is thought to be the key components of habitat. It is likely the historical range of the Northern Hairy-nosed Wombat encompassed a wider range of vegetation and soil types than at Epping Forest NP: the extinct population at Deniliquin, NSW, was reported to be on “red soil”; while the closely related Southern Hairy-nosed Wombat (*Lasiorhinus latifrons*) occurs in “areas with soil structure strong enough to support warren systems and reliable grassy ground cover” (Woinarski et al. 2014) including limestone plains, where burrows are made under calcrete.

Population density

Density at Epping Forest NP is 0.23/ha.

Reintroduction history

A total of 15 Northern Hairy-nosed Wombats were reintroduced to the Richard Underwood Nature Refuge (130 ha) near St George, Qld, in 2009-10. The reintroduction site is broadly similar in vegetation and soils to Epping Forest NP, and is fenced from cattle, dogs, foxes and cats. The population has been relatively stable since the reintroduction. Qld EHP are seeking to establish a second reintroduction site.

Expected population size within fenced area

Northern Hairy-nosed Wombats and the closely related Southern Hairy-nosed Wombats can maintain relatively high density populations in suitable habitat. Given the very limited information available on the habitat requirements of Northern Hairy-nosed Wombats outside their current range, it would be courageous to estimate population size in a potential reintroduction site such as the Pilliga. A target population would be at least 500 animals; at densities reported at Epping Forest NP, a population this size would require 2,200 ha of suitable habitat.

Prospects for release outside fenced area

Low, given historical collapse in range and highly threatened status. In the long term, it would be expected that Northern Hairy-nosed Wombats should be able to establish a population outside a fenced area, especially if cattle and dogs were controlled. The related Southern Hairy-nosed Wombat and the Common Wombat (*Vombatus ursinus*) are established across relatively large areas including land not managed for conservation.

AWC experience with species

AWC does not currently manage the Northern Hairy-nosed Wombat. Populations of the Southern Hairy-nosed Wombats are conserved on AWC’s Yookamurra and Dakalanta sanctuaries (SA). At Yookamurra, the wombats occur both inside and outside the fenced area.

Likely source populations

Discussions with Qld EHP have indicated that they are willing to consider further reintroductions after a robust population has been established on a second reintroduction site in Queensland: this will not be for at least 5-10 years. Development of improved

husbandry (e.g., cross-fostering of young to Southern Hairy-nosed Wombats) may increase the availability of animals for founding a reintroduced population.

4.4.5 Brush-tailed Bettong

Conservation status

NSW: *Bettongia penicillata* Extinct; EPBC: *B. p. penicillata* Extinct; *B. p. ogilbyi* Endangered.

Distribution

Pre-European: Arid and semi-arid Australia in southern and central Australia (Figure 14, Figure 15). Persisted in central Australia to 1930s, possibly later (Finlayson 1961; Gibson 1986; Burbidge et al. 1988). Various accounts of the Brush-tailed Bettong (including the maps presented in Figure 14 and Figure 15) differ in their interpretation of pre-European distribution, compounded by difficulties in determining the boundaries between taxa closely related to *B. penicillata*: *B. tropica* (north-east Australia) and *B. gaimardia* (south-east Australia and Tasmania); as well as the recent recognition of cryptic taxa: *B. anhydra* (central-western Australia) and *B. pusilla* (Nullarbor). The Brush-tailed Bettong was recorded as far east as the Liverpool Plains in NSW (Paull and Date, 1999). There is some contention as to whether this record represents *B. penicillata* or *B. tropica*, but one interpretation is these taxa represent clines of the same species (Woinarski et al., 2014).

Current: remnant populations in south-west WA; successfully reintroduced to various locations within south-west WA in association with fox control or to fenced areas, including AWC's Karakamia and Mt Gibson sanctuaries; reintroduced outside WA to AWC's Scotia (NSW), Yookamurra (SA) sanctuaries and several islands in South Australia. Last record from NSW 1906. Populations in unfenced areas in Southwest WA have declined catastrophically (by around 90%) since 2000.

Ecology (overview)

- Size: 1-1.5 kg
- Diet: fungi (truffles), otherwise omnivorous: invertebrates, herbage, tubers, fruit/ seeds
- Breeding: continuous under favourable conditions, 1 young, up to 3 young a season
- Average lifespan in wild: 3-5 years
- Nocturnal, terrestrial, nests in shallow scrape under vegetation thicket, in logs, rock cavities, occasionally burrows

Major threats (Mammal Action Plan)

- Foxes: severe-catastrophic, large
- Cats: severe-catastrophic, large
- Inappropriate fire regimes: severe in presence of cats and foxes, large

Habitat preferences

Habitat generalist: occupied a wide range of habitats from spinifex grasslands to forests and woodlands. Currently restricted to forests and open woodlands in WA. Reintroduced populations in WA, SA and NSW inhabit forests and mallee shrublands with understorey of grasses or shrubs.

Population density

Well-supported density estimates for Brush-tailed Bettongs in Jarrah forest in south-west WA before recent population declines were 0.2-1.6/ha; median density after decline is 0.08/ha (Wayne et al., 2013). Density at AWC's Karakamia sanctuary, St Peters and Wedge Islands (SA) is around 1/ha. Density at AWC's sanctuaries at Yookamurra and Scotia is around 0.1/ha.

Expected population size within fenced area

Assuming a density of 0.5/ha (lower end of the range reported for WA, well below density at Karakamia), population size within a 5,800 ha enclosure is predicted to be 2,900.

Reintroduction history

Brush-tailed Bettongs have been introduced successfully to numerous locations in south-west WA in conjunction with broadscale fox control, to fenced areas in WA (including AWC's Karakamia and Mt Gibson sanctuaries, as well as Perup, Whiteman Park and Wadderin) and fenced areas outside WA including AWC's Scotia (NSW) and Yookamurra (SA) sanctuaries, and to St Peters and Wedge Islands (SA). A number of reintroductions to unfenced or partly-fenced areas (e.g., Francois Peron NP, WA; Yathong NR, NSW), have failed because of predation. As indicated above, unfenced populations have declined catastrophically since 2000.

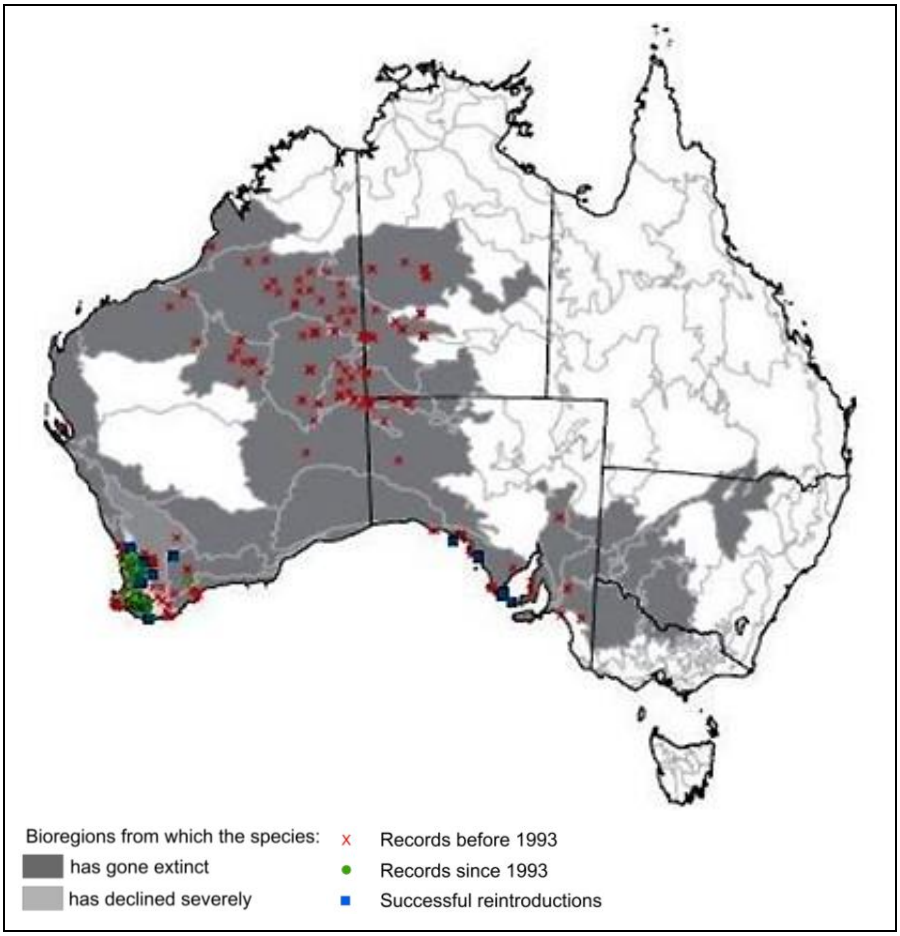


Figure 14: Brush-tailed Bettong distribution (Mammal Action Plan, Woinarski et al. 2014)

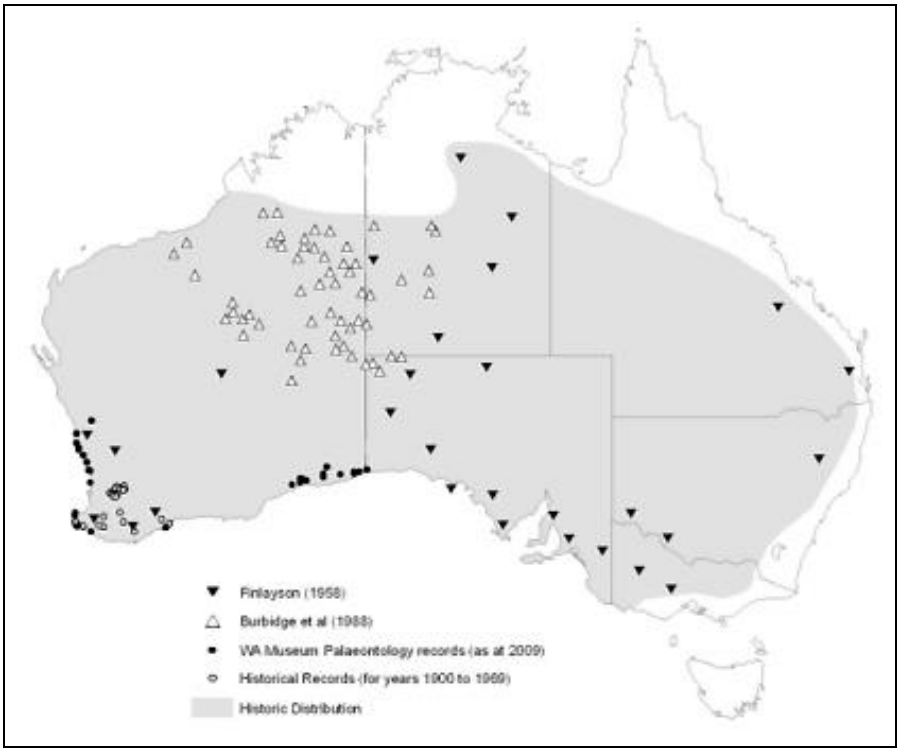


Figure 15: Brush-tailed Bettong distribution (Yeatman and Groom 2012)

Prospects for release outside fenced areas

Reintroductions outside fenced areas have a very low chance of success unless both cats and foxes can be locally eradicated, or suppressed to very low levels, which is not currently feasible in an open landscape.

AWC experience with species

Reintroduced populations of Brush-tailed Bettongs are present on four AWC sanctuaries: Karakamia (WA), Mt Gibson (WA), Scotia (NSW) and Yookamurra (SA).

Likely source populations

Considerations in relation to obtaining Brush-tailed Bettongs for translocations are (i) the major decline in wild populations (Wayne et al., 2013), and (ii) genetic issues, considered in detail for the Brush-tailed Bettong (Pacioni et al., 2013). For the Mt Gibson project, AWC has sourced Brush-tailed Bettongs from two genetically divergent locations in WA: Perup, a fenced area in Jarrah forest that is not subject to decline, and from AWC's Karakamia sanctuary in WA.

For this project, AWC would seek to engage the Brush-tailed Bettong recovery team in resolving issues around the availability of animals and optimising genetic diversity. Likely source populations include AWC's Scotia, Yookamurra, Karakamia and Mt Gibson sanctuaries, supplemented with founders from wild or semi-wild populations in WA.

4.4.6 Bridled Nailtail Wallaby

Conservation status

NSW: Extinct; EPBC: Endangered.

Distribution

Pre-European: eastern Australia west of the coastal ranges from near Charters Towers, Qld, south to north-west Victoria and possibly into South Australia (Figure 16).

Current: Restricted to a remnant population at Taunton National Park (Qld) and a reintroduced population in a feral-free area at AWC's Scotia Sanctuary (NSW). Scotia currently supports c. 2,000 animals. Last record from NSW 1924.

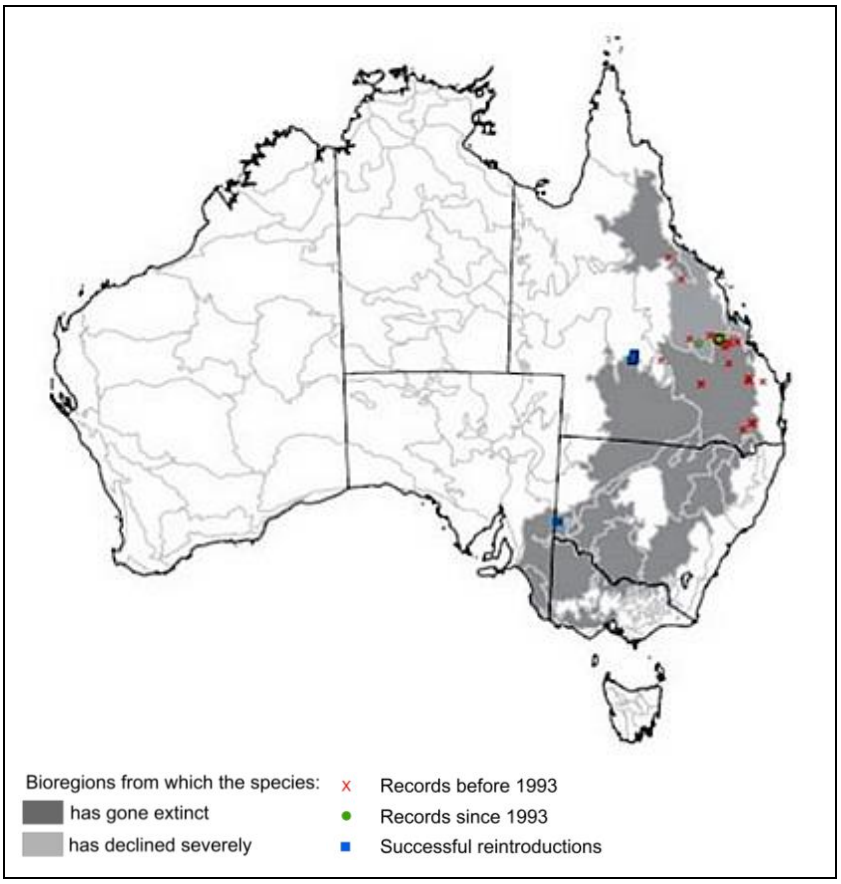


Figure 16: Bridled Nailtail Wallaby distribution (Mammal Action Plan, Woinarski et al. 2014)

Ecology (overview)

- Size: 4-6 kg
- Diet: herbivorous, mostly grasses and forbs, but can shift to browse during droughts
- Breeding: throughout year, 1 young, up to 3 young a year in favourable conditions
- Average lifespan in wild: 5-6 years
- Nocturnal
- Terrestrial
- Shelters in scrapes in dense vegetation and hollow logs

Major threats (Mammal Action Plan)

- Foxes: catastrophic, large
- Cats: severe, entire
- Dogs: severe, entire
- Drought: severe, entire
- Habitat degradation (weeds, feral herbivores): severe, large-entire

- Habitat loss: severe, entire
- Inappropriate fire regimes: moderate, entire

Habitat preferences

Acacia shrubland and grassy woodland.

Population density

Densities reported at Taunton range from 0.14-0.25/ha (for areas supporting the population). At Scotia, mean density over 2011-14 was 0.24/ha (range 0.07-0.36/ha). Populations of the Bridled Nailtail Wallaby vary considerably with rainfall: the population on Taunton collapsed by 70% during drought conditions.

Reintroduction history

Reintroduced to unfenced areas on Idalia National Park in 1993 and Avocet Nature Reserve in 2001. Although feral predators are controlled at these locations, the Idalia reintroduction has failed and the Avocet population is small. Successfully reintroduced to AWC's feral-free area at Scotia Sanctuary (Stage 1, 2004; Stage 2, 2008); this population has expanded to c. 2,000 animals.

Expected population size within fenced area

Population density at Pilliga is likely to be higher than Scotia, as it is a wetter site. If density is 50% higher (0.36 animals/ha, equivalent to the maximum observed at Scotia), population size within a 5,800 ha enclosure (as proposed for Pilliga) would be in the order of 2,100 animals.

Prospects for release outside fenced area

Reintroductions outside fenced areas have a low chance of success unless both cats and foxes can be locally eradicated or maintained at very low levels. The remnant Queensland population has declined over the last decade despite intensive predator control; the reintroduction to Idalia has failed. Cats are a significant predator (Fisher et al. 2001). An attempt by AWC to establish a population outside the fence at Scotia, in an area subject to intensive fox baiting, failed due to predation (Woinarski et al. 2014). Dogs can also be a significant source of mortality.

AWC experience with species

AWC manages the largest population of Bridled Nailtail Wallabies at Scotia sanctuary (NSW).

Likely source populations

For this project, AWC intends to source Bridled Nailtail Wallabies from Scotia sanctuary, supplemented with captive bred animals sourced from Queensland populations to maximise the genetic diversity of the reintroduced population. The genetic integrity of populations of the Bridled Nailtail Wallaby is a significant concern of the recovery group, which recently commissioned a study of the genetic structure of remnant and reintroduced populations of the species (Pacioni and Armstrong, 2013). AWC is represented on the recovery group.

4.4.7 Plains Mouse

Conservation status

NSW: Extinct; EPBC: Vulnerable.

Distribution

Pre-European: western edge of the Nullarbor Plain WA through central Australia to inland slopes of the Great Dividing Range in Qld, NSW and western Victoria (Figure 17).

Current: restricted to the Lake Eyre Basin in northern South Australia. Last record in NSW 1843.

Ecology (overview)

- Size: 30-65 g
- Diet: omnivorous: roots, leaves, seed, invertebrates
- Breeding: continuous in favourable conditions, 3-4 young
- Average lifespan in wild: probably 1-2 years
- Nocturnal
- Terrestrial
- Dens in burrows in cracking clay soils or other friable soils, sometimes communal

Major threats (Mammal Action Plan)

- Foxes: severe, entire
- Cats: severe, entire
- Habitat degradation: severe, large

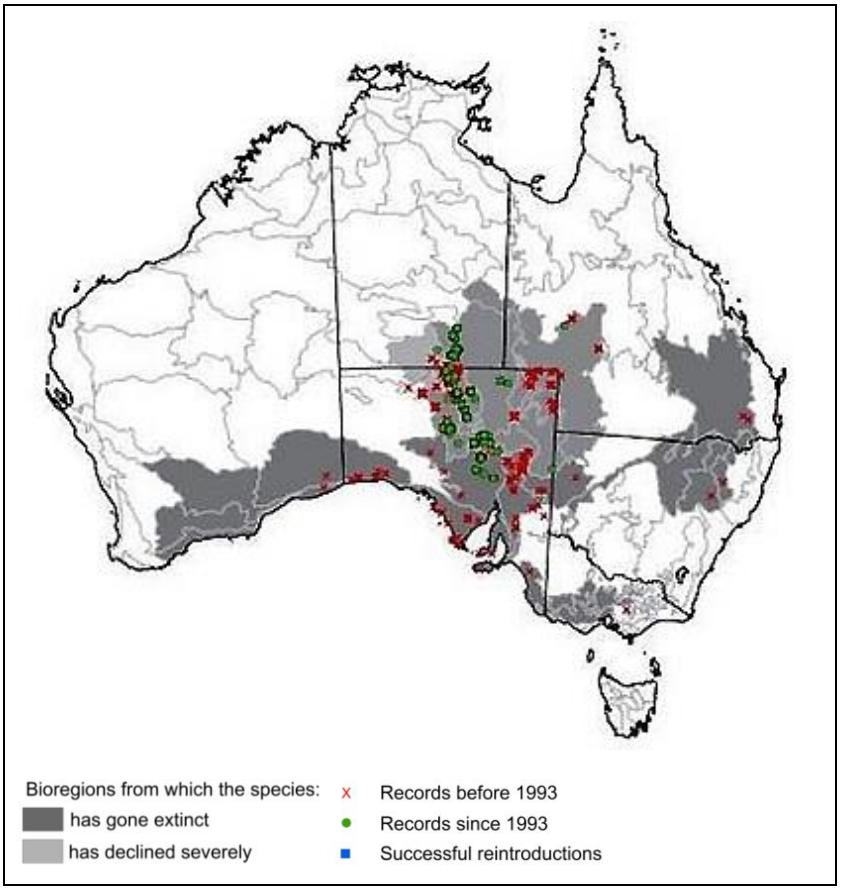


Figure 17: Plains Mouse distribution (Mammal Action Plan, Woinarski et al. 2014)

Habitat preferences

Pre-European distribution encompassed a range of arid-zone habitats. Refugial areas in current range comprise areas of cracking clay soils and gilgais in open plains. Habitat expands to sandy soils during population irruptions (Moseby, 2012).

Population density

An irruptive species. During favourable conditions, may attain 10 animals/ha in high quality habitat; but can be undetectable during drought conditions, likely contracting to refugial areas. Densities at Arid Recovery (SA) reported to be an order of magnitude higher within the fenced area than outside the fence (Moseby, 2012).

Reintroduction history

None known. Occurs naturally within fenced ‘mainland island’ at Arid Recovery (SA).

Expected population size within fenced area

Likely to vary significantly with rainfall. At maximum densities in highly favourable conditions (10/ha), population may be several tens of thousands in a 5,800 ha fenced area (as proposed for Pilliga). Population during drought likely to be several orders of magnitude lower (i.e., 0.01/ha, or hundreds of animals), depending on the availability of suitable refugial habitat. Removal of feral predators from the fenced area is likely to expand the habitat that can be relied upon for refuge. Density estimates used here are 0.1-1/ha, suggesting a population of 600-5,800 animals.

Prospects for release outside fenced area

Moderate. Species has suffered a major historical decline, but nevertheless persists in areas not subject to intensive feral predator control. Establishment of a secure population in a fenced area may facilitate the establishment of a population in the surrounding unfenced area, as animals would be able to escape the fence.

AWC experience with species

There are currently no records of Plains Mouse from any AWC sanctuary. Potentially suitable habitat occurs on Kalamurina Wildlife Sanctuary (SA).

Likely source populations

AWC would seek approval to obtain Plains Mice from wild populations in South Australia.

4.5 REASON FOR THE PROPOSAL

The reason for the activity is the conservation, including reintroduction and restoration, of threatened mammal species. This rationale is set out in detail in relevant NSW Government policy including the Saving our Species (SOS) policy (OEH, 2016). The key objectives of SOS are:

- to maximise the number of threatened species in NSW that can be secured in the wild for the next 100 years;
- to control key threats facing threatened plants and animals.

The EMA, incorporating this proposal, is a key partnership between the NSW Government and AWC under SOS.

This proposal gives effect to a specific policy commitment of the NSW Government – to reintroduce mammals that are listed as extinct in NSW. The activity will also:

- increase the health of ecosystems by restoring ecological processes (e.g., digging mammals);
- increase the level of scientific knowledge related to threatened mammal conservation and conservation in the Pilliga generally;
- increase opportunities for community engagement in conservation.

There are no practical alternatives which will achieve the relevant objective in the SOS. In particular, there is no practical alternative that will ensure the successful reintroduction of regionally extinct mammals. Failure to take action to protect and restore threatened mammal populations will increase the risk of additional extinctions.

4.6 TIMING OF THE PROPOSAL

Subject to relevant approvals, it is proposed that construction of the conservation fence will commence as soon as possible after approval is granted (about November 2017). The fence will be constructed within 10 months of approvals being granted (by about mid-late 2018). Feral predator removal is scheduled for completion within 8 months of completion of the fence (i.e. 18 months after approvals – by about early 2019). The proposed operations base will be completed within 18 months of approvals being granted (i.e. by about early 2019). Reintroductions will commence by March 2019, with 5 regionally extinct mammal species reintroduced by April 2021. Reintroductions are dependent on eradication of feral predators

from within the fenced area (see Section 4.3.4). The details of reintroductions will be provided in the Translocation Proposal to be developed for the proposal site. In brief, the herbivorous and omnivorous species will be reintroduced first, the carnivorous Western Quoll will be reintroduced last. Amongst herbivorous and omnivorous species, there is no particular order of reintroductions as no specific interactions amongst these species are expected. The timing of reintroductions will depend on the availability of source animals and other factors to be identified in the Translocation Proposal. Animals will be released directly into areas of suitable habitat within the large fenced area. For some species, temporary fencing may be used to establish a small holding pen to prevent a 'flight response' in released animals; again, details will be provided in the Translocation Proposal.

Generally, construction of the proposed fence, operations base and management trail would be undertaken during standard construction hours:

- Monday to Friday 7 a.m. to 6 p.m.
- Saturday 8 a.m. to 1 p.m.
- no work on Sundays or public holidays.

However, some construction may occur outside these hours if required for operational reasons.

5 EXISTING ENVIRONMENT

5.1 METEOROLOGICAL DATA

The climate of the Pilliga EMA project area has hot summers and cool winters. Mean maximum temperatures range between about 34°C in summer and 17°C in winter (Figure 18). Mean annual rainfall is 660 mm (Narrabri West Post Office) (BOM, 2017). Rainfall, on average, is distributed throughout the year with a peak in the summer, however, heavy rainfall events may occur at any time of the year (Figure 19). Heavy rain was recorded in autumn 2015, but not in autumn 2016 (which was extremely dry), while heavy rain was recorded in winter and spring 2016, but not in spring 2015.

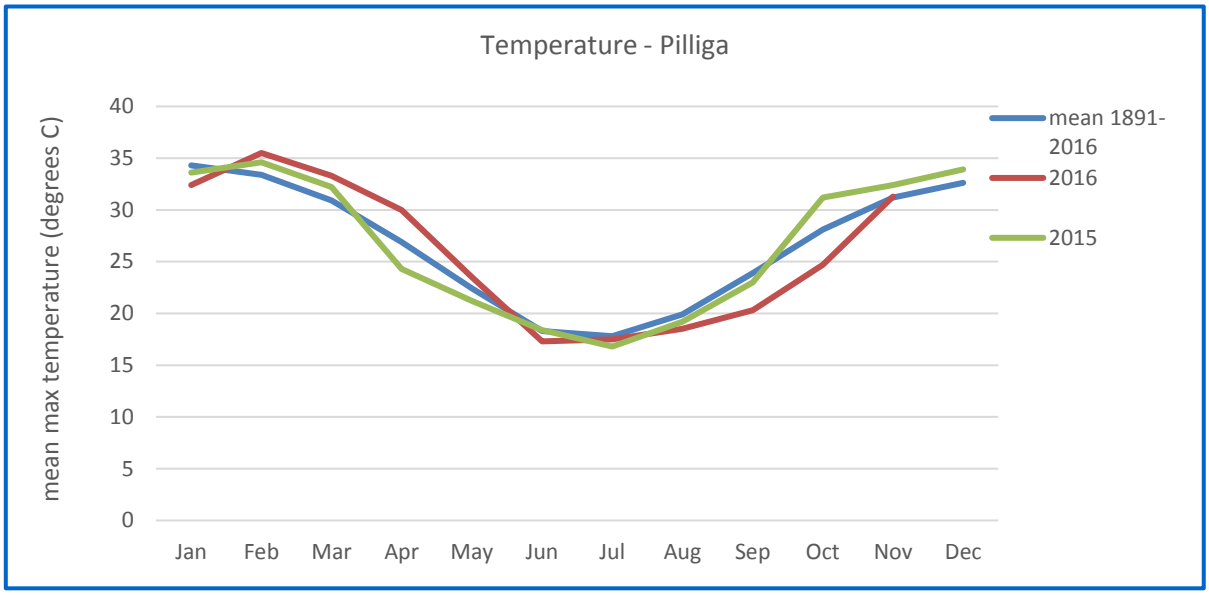


Figure 18: Average Monthly maximum temperatures (degrees Celsius) at the Narrabri West Post Office.

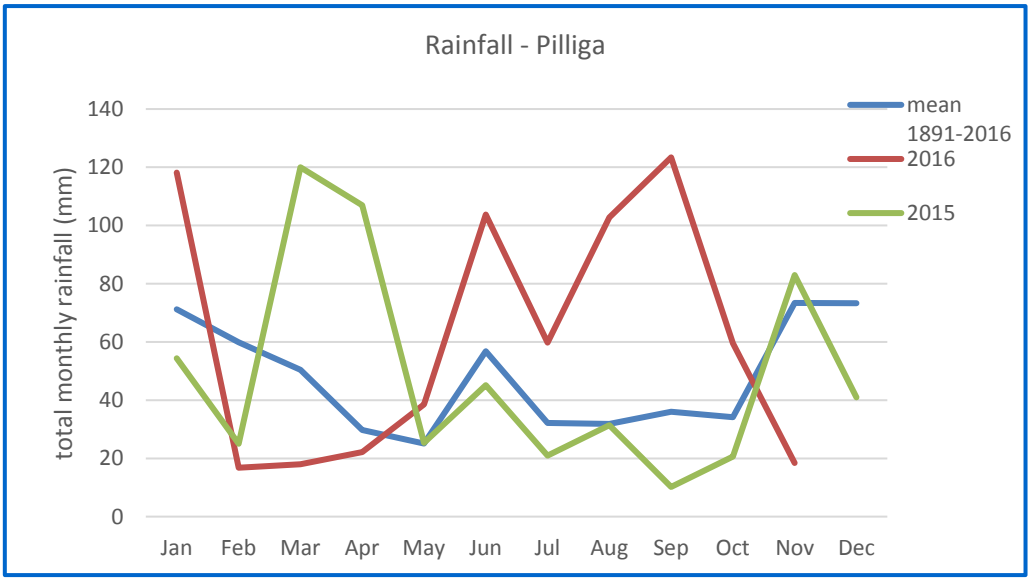


Figure 19: Average monthly rainfall (millimetres) at the Narrabri West Post Office.

5.2 TOPOGRAPHY

The landforms of the study area are generally low relief, with a topographic range of between five and nine metres (Mitchell, 2002).

5.3 SURROUNDING LAND USE

The proposal is entirely surrounded by Pilliga NP, Pilliga SCA (which the proposal is located within) and Pilliga East State Forest. These areas are set aside for conservation and, in the case of the State Forest, forestry production.

Camping and four-wheel driving are activities that are likely to occur within the SCA. Mineral exploration is permitted but subject to development consent within the Pilliga SCA. Bee-keeping is allowed at specific sites under license.

5.4 GEOLOGY/GEOMORPHOLOGY

To gain a more detailed understanding of the landscapes within the study area, information was taken from the NSW Mitchell Landscapes (Mitchell, 2002). These provide a geological description of the landscapes of each bioregion within NSW. The study area is within the Barradine Alluvial Plains, Barradine-Coghill Channels and Floodplains and Coghill Alluvial Plains (Figure 20). Coghill Alluvial Plains are Quaternary alluvial fans largely derived from Jurassic quartz sandstone on streams draining from the Pilliga forests. Barradine Alluvial Plains are similar to those of the Channels and Floodplains which comprise sandy incised channels and distributary streams on Quaternary alluvium.

5.5 SOIL TYPES AND PROPERTIES

The study area is defined by three Mitchell landscapes; Barradine Alluvial Plains, Barradine-Coghill Channels and Floodplains and Coghill Alluvial Plains (Mitchell, 2002).

These are characterised by deep texture-contrast soils with harsh clay subsoils, grey clay with gilgais and uniform deep yellow sands. Sediments and soils become finer down the Pilliga outwash merging with the Coghill Alluvial Plains ecosystem.

Long gentle slopes are broken by sandy abandoned stream channels (sand monkeys), patches of heavy grey clay, and contemporary incised stream channels. These have deep texture-contrast soils with harsh clay subsoils and grey clay with gilgais.

5.6 WATERWAYS

Coghill Creek is located in relatively close vicinity to the proposal (Figure 21). Coghill Creek is considered one of the main drainage systems within the Pilliga, with the catchment feeding into the largest area of gilgais in the Brigalow Belt South Bioregion (OEH, 2014). However, all waterways in the EMA project area are ephemeral. Several minor ephemeral creeks also occur within the proposed feral predator-free area.

5.7 CATCHMENT VALUES

The proposal area is part of the Pilliga forests which form the largest continuous extent of remnant vegetation in NSW, west of the Great Dividing Range.

The study area is located within the largely unpolluted catchment of the Pilliga forest (NPWS, 2002). The proposed development of the coal-seam gas industry in this catchment is addressed in the Santos EIS (GHD, 2017).

The study area is also likely to be important in maintaining high water quality in the Namoi catchment. Coghill Creek is one of the main drainage systems that feed the largest area of gilgais in the Brigalow Belt South Bioregion (OEH, 2014). The Pilliga forest is also considered a major recharge area of the Great Artesian Basin (NPWS, 2002).

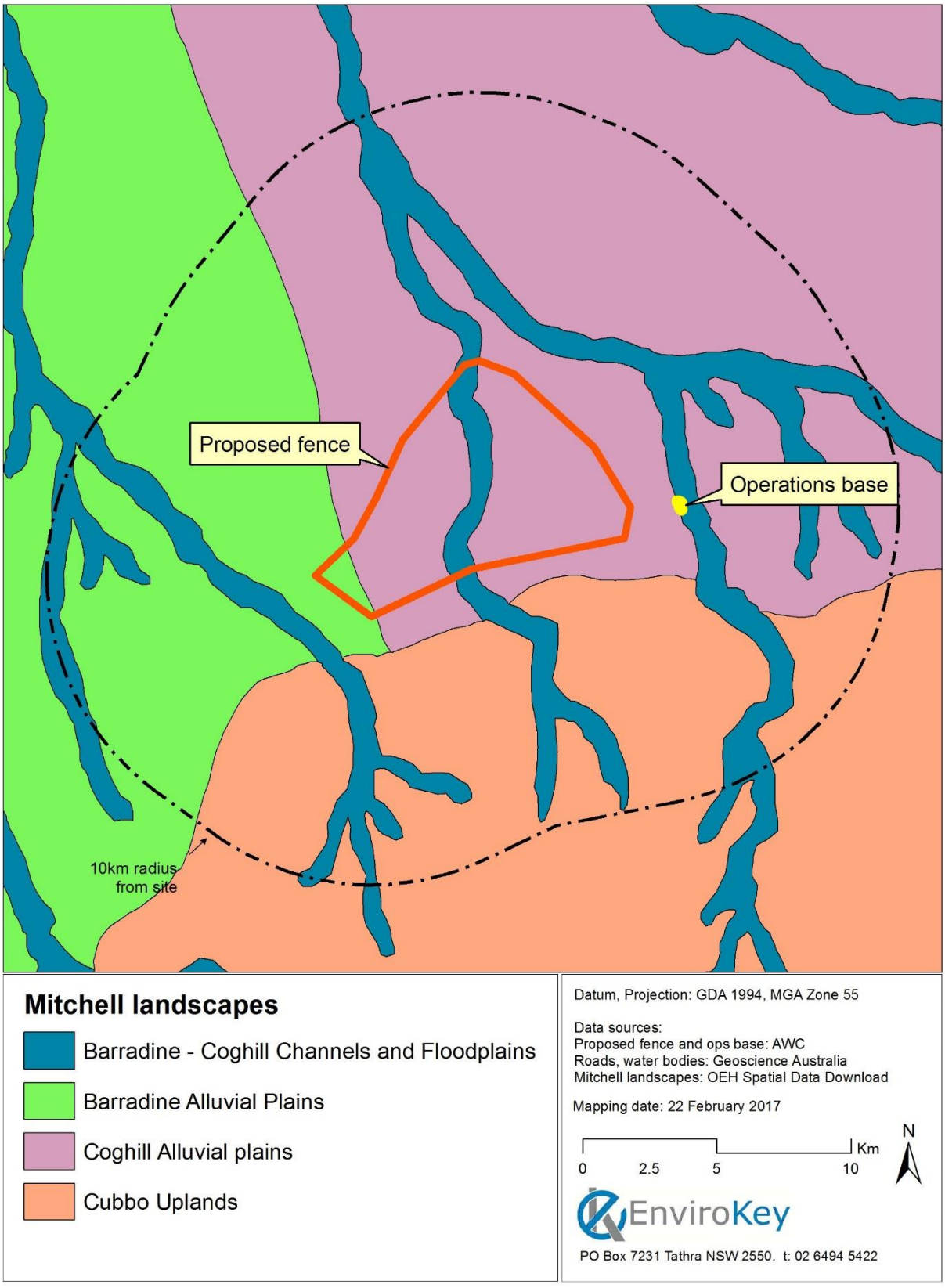


Figure 20: Mitchell landscapes of the locality

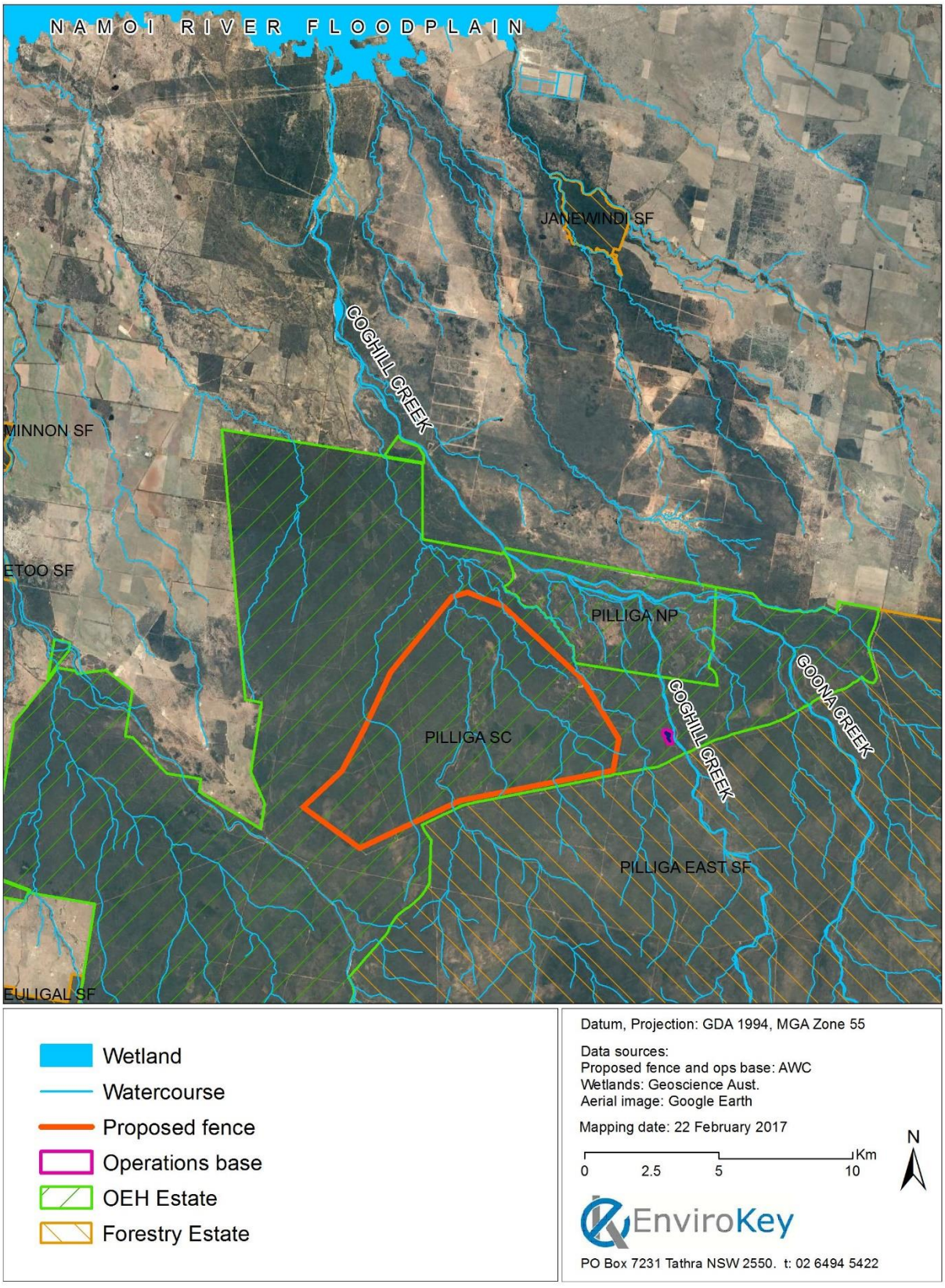


Figure 21: Watercourse and wetlands in the wider locality

5.8 FLORA AND FAUNA

5.8.1 Desktop analysis

A desktop analysis was completed to source information on threatened and migratory biota that might use the resources of the study area. Information was sought from BioNET – the Atlas of NSW Wildlife (which includes flora) for records of threatened flora and fauna recorded within a 50 km radius of the centre of the study area on 21 February 2017. These records are detailed in Figure 22 to Figure 24 at a scale permissible by OEH data license agreement (1:250,000). Similarly, information on threatened and migratory species listed under the EPBC Act that could occur in the locality was sourced using the Protected Matters Search Tool by applying a 50 km buffer around a central point within the proposed feral predator-free area (latitude -30.52418; longitude 149.27691). The PMST report is in Appendix 2.

5.8.2 Field survey

Flora and vegetation community surveys

The vegetation communities of the Pilliga SCA and NP have been described in detail (a 297-page report) and mapped by Hunter (2010). These data were compiled and ground-truthed from existing plot-based floristic surveys (50 x 0.1 ha plots) and 59 additional 0.04 ha floristic plots. From these data, 13 vegetation communities were identified, 12 of which occur in the study area (Table 6). The distribution of these vegetation communities in the study area was mapped, guided by the earlier mapping developed by Lindsay (1967). Detailed floristic descriptions of each of these communities, including full species lists within each of these communities, is provided by Hunter (2010).

Field inspection of the proposed CFAI was conducted in December 2016 by AWC botanists. The vegetation communities were classified using the comprehensive mapping and vegetation classifications of Hunter (2010) and then ground-validated by AWC botanists. Vegetation communities were then classified into the corresponding Plant Community Type (PCT) using the VIS database (OEH, 2017c) and Hunter's (2010) re-classification of his vegetation types. The PCT vegetation classification in the Pilliga SCA and NP was developed based on remote-sensing and modelling using little additional ground-truthing data. The PCTs and corresponding Hunter classes are listed in Table 6.

Fauna surveys

AWC conducted baseline inventory and monitoring surveys during spring 2016 across 50 sites in Pilliga SCA and Pilliga NP (Gilgai section). Monitoring sites were arranged within a 2.5 km grid which covers the entire EMA project area (n = 50). The spring 2016 survey period consisted of diurnal bird surveys, nocturnal fauna listening, call-playback and spotlighting transects, and motion-detecting remote cameras located at each of the 50 monitoring points and at the nearest points on adjacent roads giving a total of 100 camera assessment locations.

Bird surveys were carried out on three occasions by different observers at each of the 50 monitoring sites using the *Birdlife Australia* standard 20-minute active search (all birds seen or heard within 200 x 100 m transect), over two hectares. Camera-traps were deployed at each monitoring site (n = 50) and the nearest road point (n = 50). Cameras were programmed to take three images per trigger, with a five-minute delay between triggers.

Each camera was attached to a star picket or tree trunk at 50 cm above ground level; a sealed perforated lure tube containing a chicken neck was placed in front of the camera.

Spotlighting surveys consisted of a listening period (10 minutes); a series of Koala and Barking Owl call-playbacks, with 30 second silent intervals between playback; and active spotlighting search along a 400 m transect. All animals heard or seen were recorded together with the species, the estimated distance along the transect and the compass bearing to the animal. Each of the 50 monitoring sites was visited on two separate occasions.

5.8.3 Nomenclature

Flora classification in this REF follows the online version of the Flora of NSW (PlantNET, 2017) and relevant OEH databases (OEH, 2017a, OEH, 2017c). Nomenclature for fauna was guided by the following texts: birds, IOC World Bird List 7.2; mammals, Woinarski et al. (2014); frogs and reptiles Cogger (2014).

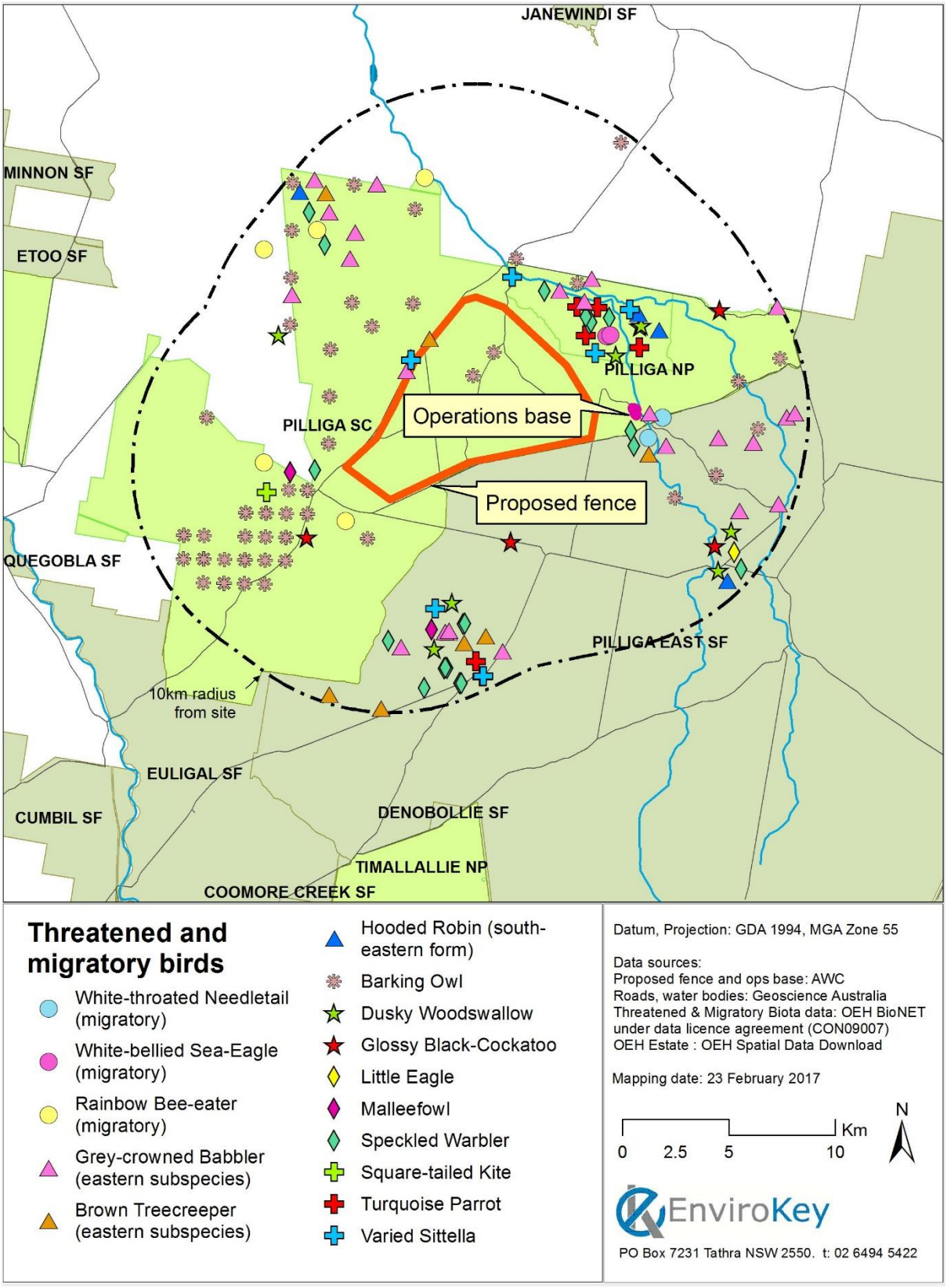


Figure 22: Previous records of threatened and migratory birds in locality

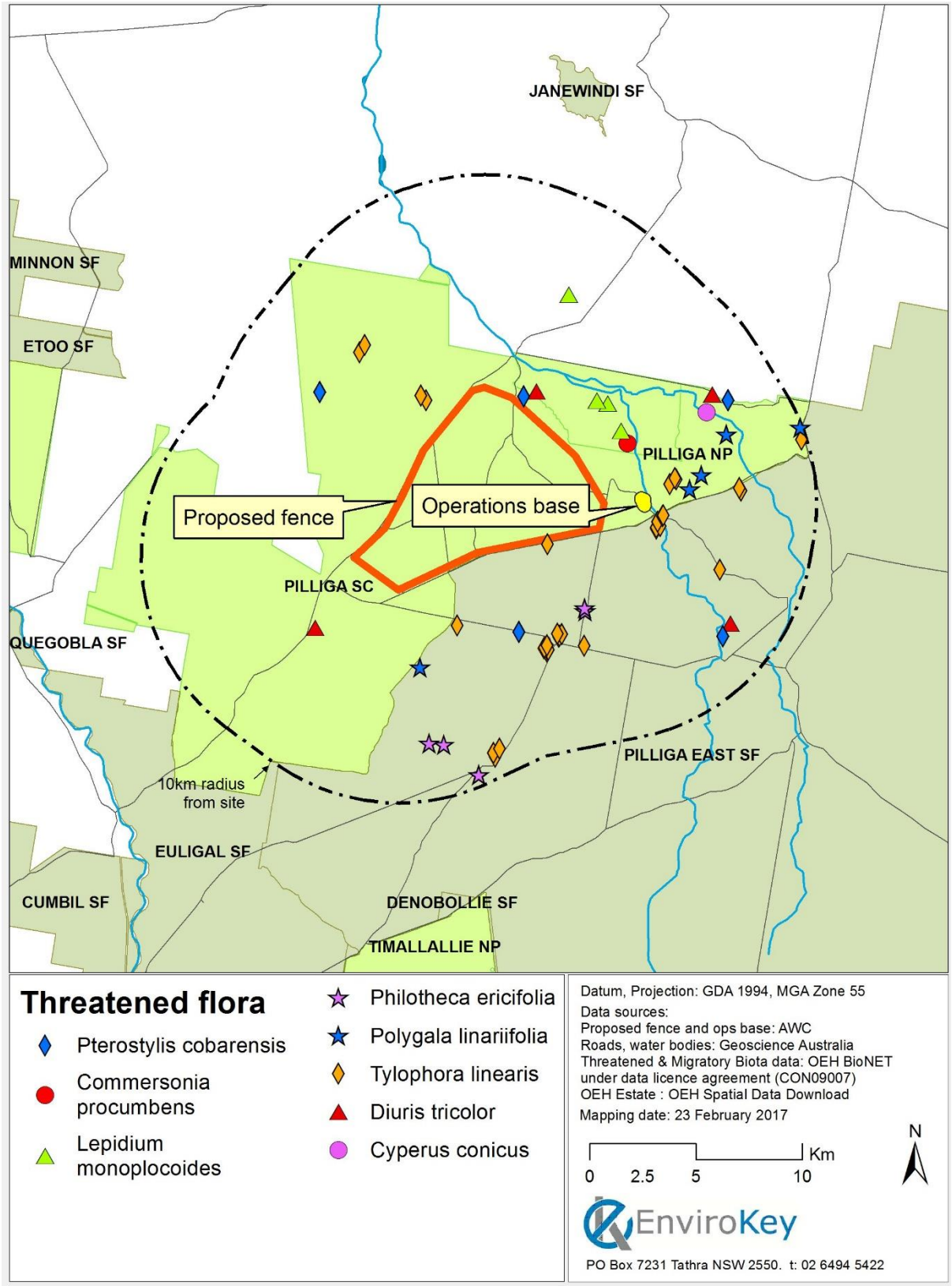


Figure 23: Previous records of threatened flora in locality

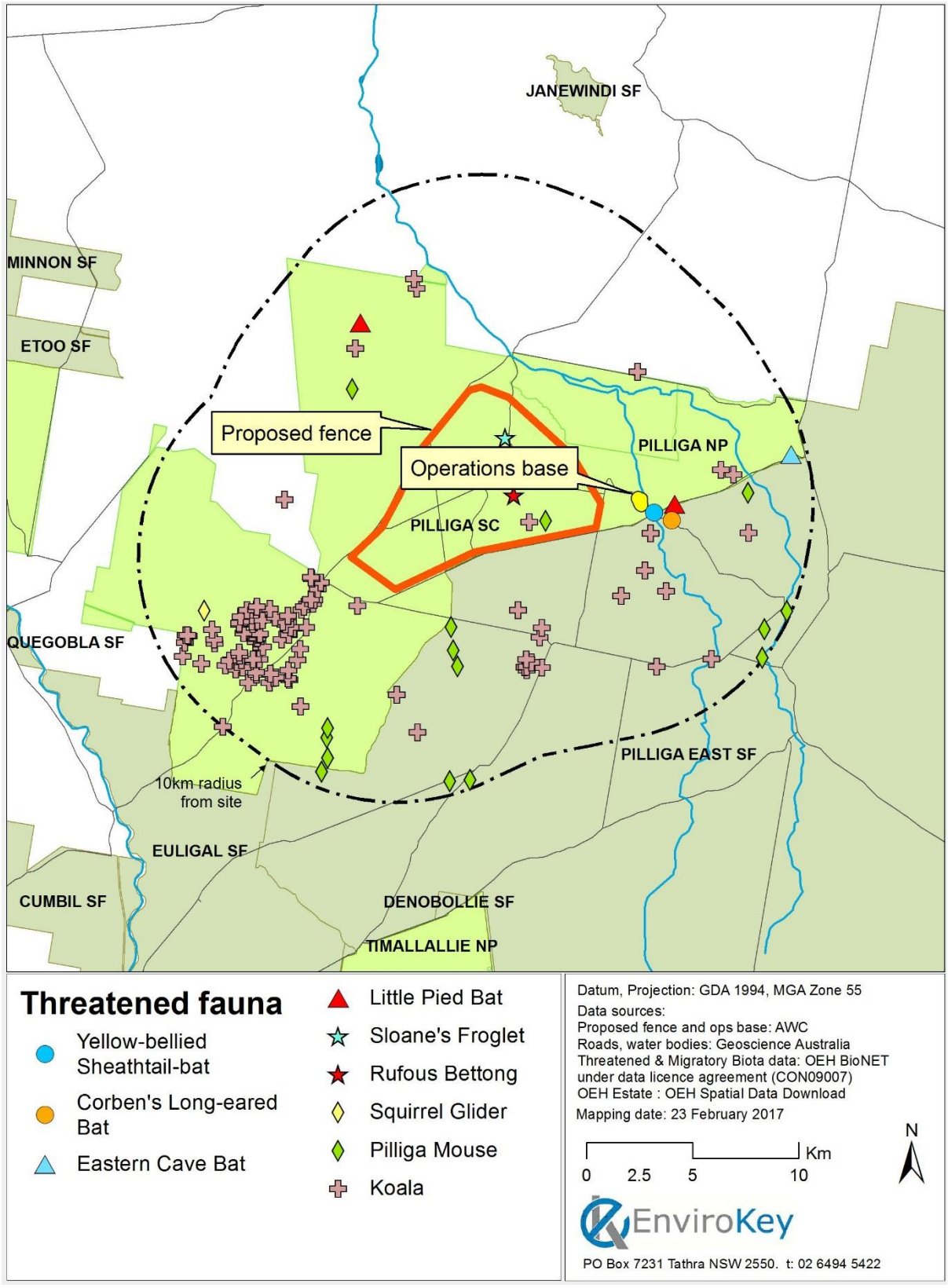


Figure 24: Previous records of other threatened fauna in locality

5.8.4 Results

5.8.4.1 *Flora and Vegetation Communities*

Species Richness

A total of 530 terrestrial flora species from 89 families and 271 genera have been recorded within the vicinity of the proposal as detailed by Hunter (2010).

Plant Community Types

Field inspections by AWC botanists confirmed that vegetation mapping by Hunter (2010) is relatively accurate, with no additional vegetation types found. Descriptions of characteristic species for Plant Community Types (PCTs) were also found to be typical of those PCTs found along the fenceline during the inspection. The PCTs known from the vicinity of the proposed CFAI and adjacent areas, in relation to the Hunter (2010) vegetation communities, are as follows:

- PCT 411 Buloke-White Cypress Pine woodland on outwash plains in the Pilliga Scrub and Narrabri regions, Brigalow Belt South Bioregion ecotonal with PCT 410 Swamp Paperbark very tall shrubland wetland on sodic soils in the Pilliga Scrub region (Hunter C7)
- PCT 411 Buloke-White Cypress Pine woodland on outwash plains in the Pilliga Scrub and Narrabri regions, Brigalow Belt South Bioregion ecotonal with PCT 402 Mugga Ironbark-White Cypress Pine-gum tall woodland on flats in the Pilliga forests and surrounding regions, Brigalow Belt South Bioregion (Hunter C8)
- PCT 88 Pilliga Box-White Cypress Pine-Buloke shrubby woodland in the Brigalow Belt South Bioregion (Hunter C9)
- PCT 415 Fringe Myrtle shrubland of the Pilliga Scrub (Hunter C5)
- PCT 401 Rough-barked Apple-Blakely's Red Gum-Black Cypress Pine woodland on sandy flats, mainly in the Pilliga Scrub region (Hunter C3)
- PCT 399 Red Gum-Rough-barked Apple +/- tea tree sandy creek woodland (wetland) in the Pilliga-Goonoo sandstone forests, Brigalow Belt South Bioregion (Hunter C2)
- PCT 404 Red Ironbark-White Bloodwood +/- Burrows Wattle heathy woodland on sandy soil in the Pilliga forests (Hunter C6)
- PCT 399 Red Gum-Rough-barked Apple +/- tea tree sandy creek woodland (wetland) in the Pilliga-Goonoo sandstone forests, Brigalow Belt South Bioregion ecotonal with PCT 397 Poplar Box-White Cypress Pine shrub grass tall woodland of the Pilliga-Warialda region, Brigalow Belt South Bioregion (Hunter C1)
- PCT 55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (Hunter C12)
- PCT 416 Pilliga tank gilgai wetland sedgeland rushland, Brigalow Belt South Bioregion (Hunter C11)
- PCT 141 Broombush-wattle very tall shrubland of the Pilliga to Goonoo regions, Brigalow Belt South Bioregion ecotonal with PCT 256 Green Mallee tall mallee woodland on rises in the Pilliga-Goonoo regions, southern Brigalow Belt South Bioregion (Hunter C4)
- PCT 395 Derived speargrass-wallaby grass-wire grass mixed forb grassland mainly in the Coonabarabran-Pilliga-Coolah region (Hunter C10)

The PCTs within and adjacent to the proposal are shown spatially on Figure 25 and the extent of each within Table 6.

The proposal area is part of the Pilliga forests which form the largest continuous extent of remnant vegetation in NSW, west of the Great Dividing Range. White Cypress Pine *Callitris glaucophylla* is the most widespread tree in the Pilliga forests. It is found in various associations (vegetation types) with other trees including Narrow-leaved Ironbark *Eucalyptus creba*, Buloke *Allocasuarina luehmannii*, several species of Red Gum (including Blakely's Red Gum *Eucalyptus blakelyi* and River Red Gum *Eucalyptus camaldulensis*), Rough-barked Apple *Angophora floribunda*, Pilliga Box *Eucalyptus pilligaensis* and Poplar Box *Eucalyptus populnea*. To the east of the proposal area, Black Cypress Pine *Callitris endlicheri* becomes more common where it is often associated with heathy formations, including Brown Bloodwood *Corymbia trachyphloia* and Broad-leaved Ironbark *Eucalyptus fibrosa*. Broombush (*Melalueca* spp.) forms a distinctive vegetation type in the EMA project area.

There is a gradation in the occurrence of vegetation communities throughout the proposal area and the broader Pilliga forests. The occurrences of many communities are associated with soil hydrology. For example, Tank Herbfield communities (PCT 416), which support the endangered herb *Myriophyllum implicatum*, are associated with the occurrence of ephemeral wetlands in shallow topographic depressions (Table 6). Rough-barked Apple-River Red Gum Forest and Woodlands (PCT 399) and White Cypress Pine-Dirty Gum Woodlands (PCT 401) are also associated with topographic depressions and ephemeral creeks but on well-drained sandy soils. In contrast, Broombush-Heath Myrtle Shrublands (PCT 141 ecotonal with PCT 256) and Fringe Myrtle-Westringia shrublands (PCT 415) occur at the opposite end of the hydrology spectrum, on well-drained, but deeper, wetter, sandy-clay-loams. Despite the few communities which show strong relationships with soil hydrology, the majority of vegetation communities in the Pilliga forests occur under similar environmental conditions, with communities distinguished by the occurrence of one or two key additional species (Table 7). The occurrence of these additional species may be driven by subtle differences in soil nutrients, disturbance history, micro-climate and topography.

Table 6: Estimated extents of Plant Community Types (PCTs), together with comparable Hunter (2010) classes (in brackets), within the EMA project area and proposal area

Vegetation Community	Area in EMA project area (ha)	Area within proposed fenced area (ha)	Portion of EMA project area PCT in proposed fenced area (%)	Portion of proposed fenced area (%)	Area in proposed operation base (ha)	Portion of EMA project area PCT in proposed operation base (%)	Portion of proposed operation base (%)
PCT 411/410 (C7)	13,792	2,512.1	18	43	0.0	0	0
PCT 411/402 (C8)	8,510	1,202.2	14	21	8.1	0.1	79
PCT 88 (C9)	4,011	845.7	21.	15	2.0	0.05	20
PCT 415 (C5)	1,380	418.6	30	7	0.0	0	0
PCT 401 (C3)	3,153	397.2	13	7	0.0	0	0
PCT 399 (C2)	2,213	185.7	8	3	0.2	0.01	2
PCT 404 (C6)	622	142.6	23	2	0.0	0	0

Vegetation Community	Area in EMA project area (ha)	Area within proposed fenced area (ha)	Portion of EMA project area PCT in proposed fenced area (%)	Portion of proposed fenced area (%)	Area in proposed operation base (ha)	Portion of EMA project area PCT in proposed operation base (%)	Portion of proposed operation base (%)
PCT 399/397 (C1)	437	0.0	0	0	0.0	0	0
PCT 55 (C12)	230	98.5	43	2	0.0	0	0
PCT 416 (C11)	83	13.4	16	0.2	0.0	0	0
PCT 141/256 (C4)	1,315	5.9	0.5	0.1	0.0	0	0
PCT 395 (C10)	2	0.0	0	0	0.0	0	0
Total	**35,748**	**5,821.7**			**10.3**		

Table 7: Key differentiating species and their occurrences (as dominants) in each of the Hunter (2010) vegetation communities

Key Species	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Callitris glaucophylla	X		X				X	X	X			
Eucalyptus populnea	X											
Angophora floribunda		X										
Eucalyptus camaldulensis		X										
Eucalyptus chloroclada			X									
Melaleuca uncinata				X								
Micromyrtus sessilis				X								
Calytrix tetragona					X							
Westringia cheelii					X							
Acacia burrowii						X						
Eucalyptus fibrosa						X						
Corymbia trachyphloia						X						
Allocasuarina luehmannii							X	X				
Eucalyptus pilligaensis							X		X			
Eucalyptus crebra								X	X			

Key Species	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Tripogon loliiformis										X		
Enteropogon acicularis										X		
Bulbine semibarbata											X	
Calandrinia eremaea											X	
Geijera parviflora												X
Casuarina cristata												X

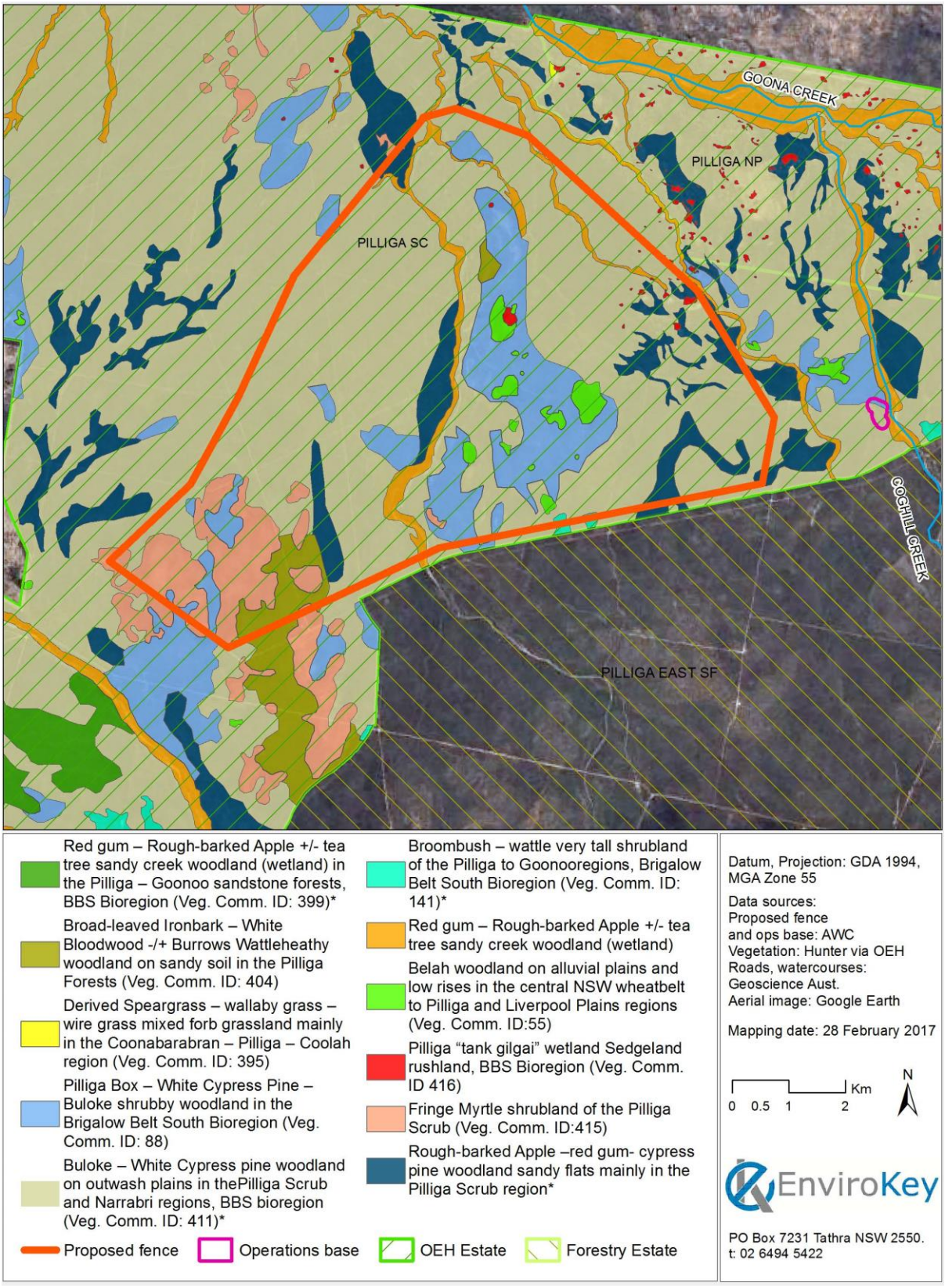


Figure 25: Plant Community Types within and adjacent to the proposal (NB: Veg. Comm. ID = PCT code number)

Weeds

The EPBC Act Protected Matters Search Tool identified seven weeds of national significance (WoNS) as species or species habitat likely to occur within the study area. These being:

- Tiger Pear (*Opuntia aurantiaca*)
- Prickly Pear (*Opuntia stricta*)
- African Boxthorn (*Lycium ferocissimum*)
- Parthenium Weed (*Parthenium hysterophorus*)
- Radiata Pine (*Pinus radiata*)
- European Blackberry (*Rubus fruticosus* aggregate)
- Pussy Willow (*Salix* spp)
- Athel Pine (*Tamarix aphylla*)

Two listed noxious weeds, Prickly Pear and Tiger Pear, were identified within the proposal area. Tiger Pear plants (individuals or small clumps) were recorded at 10 locations during fenceline surveys. Prickly Pear plants were recorded at 53 locations along the fenceline and at 10 locations at the operations base site. Both species are Class 4 weeds under the *Noxious Weeds Act 1993*. This means that the growth and spread of these weeds must be controlled according to the measures specified in a management plan published by the local control authority, and the plants may not be sold, propagated or knowingly distributed. Narrabri Shire Council has a management plan for Prickly Pear.

Additional weeds known from the broader EMA project area are listed in Table 8.

Table 8: Weed species identified by AWC botanists during flora surveys in 2016

Scientific name	Common name
Opuntia aurantiaca	Tiger Pear
Opuntia stricta	Prickly Pear
Opuntia tomentosa	Velvet Tree Pear
Cylindropuntia imbricata	Devil's Rope Pear
Lactuca serriola	Prickly Lettuce
Hypochaeris radicata	Catsear
Hypochaeris glabra	Smooth Catsear
Hypochaeris microcephala	White Flatweed
Sonchus oleraceus	Common Sowthistle
Xanthium spinosum	Bathurst Burr
Conyza sumatrensis	Tall Fleabane
Conyza bonariensis	Flaxleaf Fleabane
Cirsium vulgare	Spear Thistle
Cenchrus ciliaris	Buffel Grass
Echium plantagineum	Paterson's Curse
Chloris virgata	Feathertop Rhodes Grass
Hordeum leporinum	Barley Grass
Hyparrhenia hirta	Coolatai Grass
Vulpia myuros	Rats Tail Fescue
Cyclospermum leptophyllum	Slender Celery
Lycium ferocissimum	African Boxthorn

Bidens pilosa	Cobblers Pegs
Sida rhombifolia	Paddy's Lucerne
Verbena bonariensis	Purpletop
Bryophyllum delagoense	Mother of Millions
Anagallis arvensis	Scarlet Pimpernel
Datura stramonium	Common Thornapple
Gnaphalium polycaulon	
Lepidium africanum	
Polycarpon tetraphyllum	Four-leaved Allseed
Spergularia diandra	Lesser Sand-spurry
Chenopodium ambrosioides	Mexican Tea, Wormseed
Centaurium tenuiflorum	
Lamium amplexicaule	Henbit, Dead Nettle
Linaria arvensis	
Vicia sativa	Vetch

Threatened Flora and Threatened Ecological Communities

Field surveys by AWC botanists identified the presence of three threatened flora species within the proposal area:

- *Commersonia procumbens*, vulnerable, BC Act and EPBC Act (listed as *Androcalva procumbens* under the latter)
- *Tylophora linearis*, vulnerable BC Act, endangered EPBC Act
- *Myriophyllum implicatum,* critically endangered BC Act

The locations of AWC records for these threatened flora are shown in Figure 27, Figure 28, Figure 31, Figure 33 and Figure 34.

There was one Threatened Ecological Communy (TEC) listed in the BC Act recorded by AWC botanists in the proposal area. This was ‘Pilliga Outwash Ephemeral Wetlands in the Brigalow Belt South Bioregion’. No TECs listed in the EPBC Act were recorded in the study area.

Commersonia procumbens, vulnerable, BC Act and EPBC Act

This species is endemic to NSW and is often associated with disturbed habitats. Threats include vegetation clearance, competition from woody shrubs, and inappropriate fire regimes (OEH, 2017d). Fire and disturbance triggers germination, whilst undisturbed seeds may persist for a long time (OEH, 2017d). Many hundreds of plants were observed by AWC in 2016 and 2017. One collection (from adjacent to Old Fence Road, Figure 26) was sent to the National Herbarium of NSW where the identification was confirmed, and the specimen retained for their collection.

Field inspections by AWC included searches of all suitable habitat for *Commersonia procumbens* within the EMA project area, concentrating along the line of the proposed fence, the route of the proposed management trail, and the site of the proposed operations base. It was found to occur only in very recently burnt (<4-5 years) vegetation of either Fringe Myrtle-Westringia heath (PCT 415, C5), Broombush heath (PCT 141/256, C4), or Burrow’s Wattle woodland (PCT 404, C6). This plant is particularly abundant (often the dominant low ground

cover) in areas burnt in 2015 (Figure 27). Individuals were found only very rarely in heathlands burnt in 2012, where plants were most common on the road edge where grading of the road had possibly extended the germination period. It was not found in very similar heathlands nearby which were burnt in 2010.

Figure 26: *Commersonia procumbens* photographed near Old Fence Road during the December 2016 inspection. This specimen was sent to the National Herbarium of New South Wales to confirm its identity. Photo by AWC.

AWC surveys in transects perpendicular to Broom Road found that this species was abundant throughout that heathland patch (Figure 28 and Figure 29).

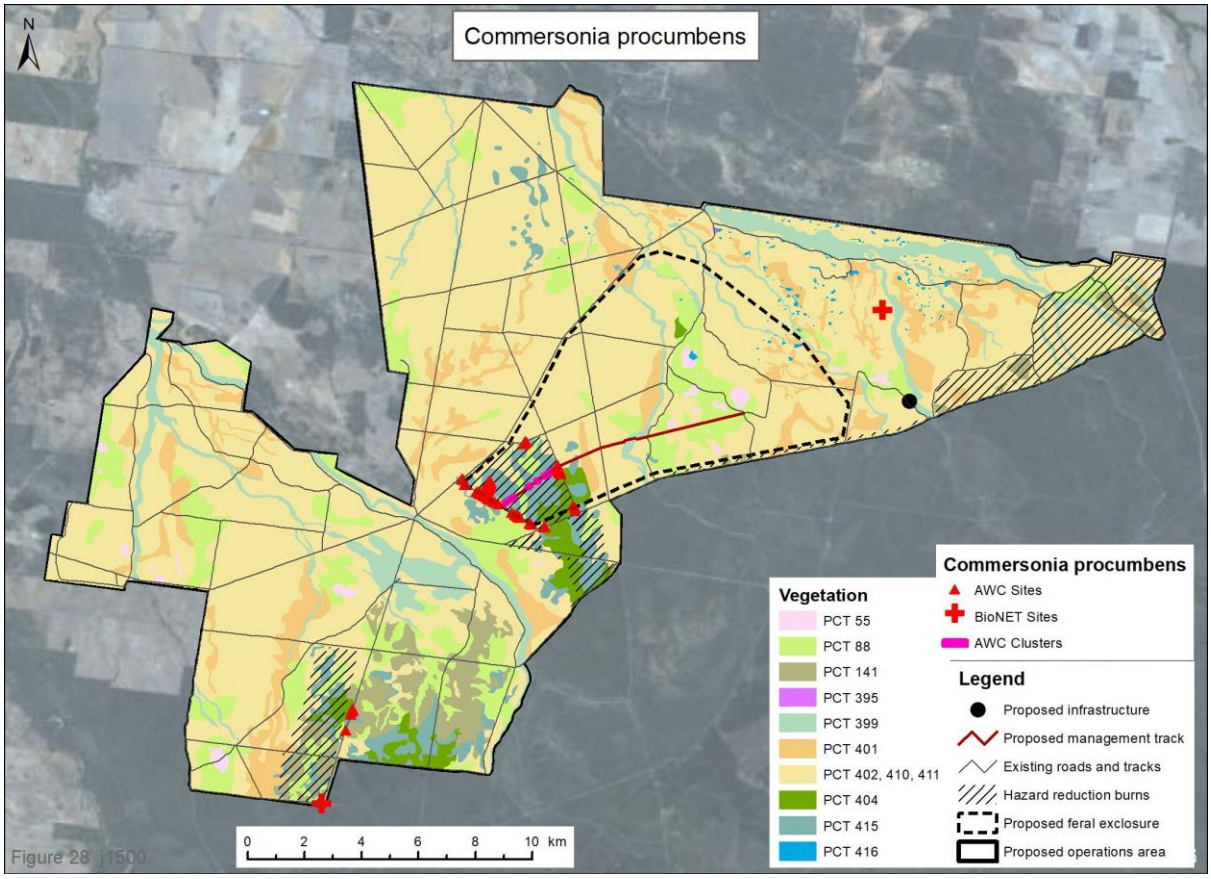


Figure 27: Records of *Commersonia procumbens* from AWC field surveys in the study area and from BioNET extracted December 2016. See Figure 28 for larger scale map of locations along proposed fenceline and management trail

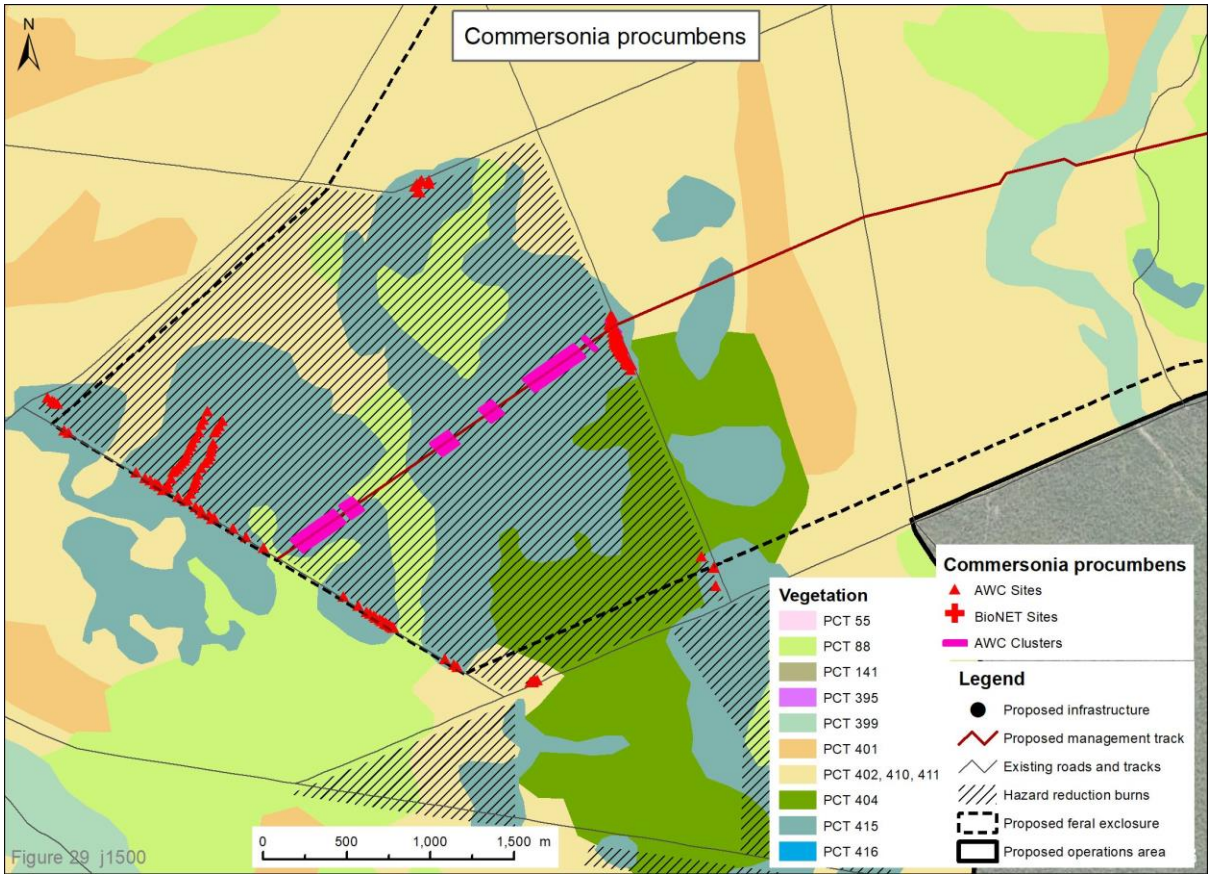


Figure 28**:** *Commersonia procumbens* locations found during surveys along the route of the proposed fence, the route of the proposed management trail, and in two transects across a recently burnt area

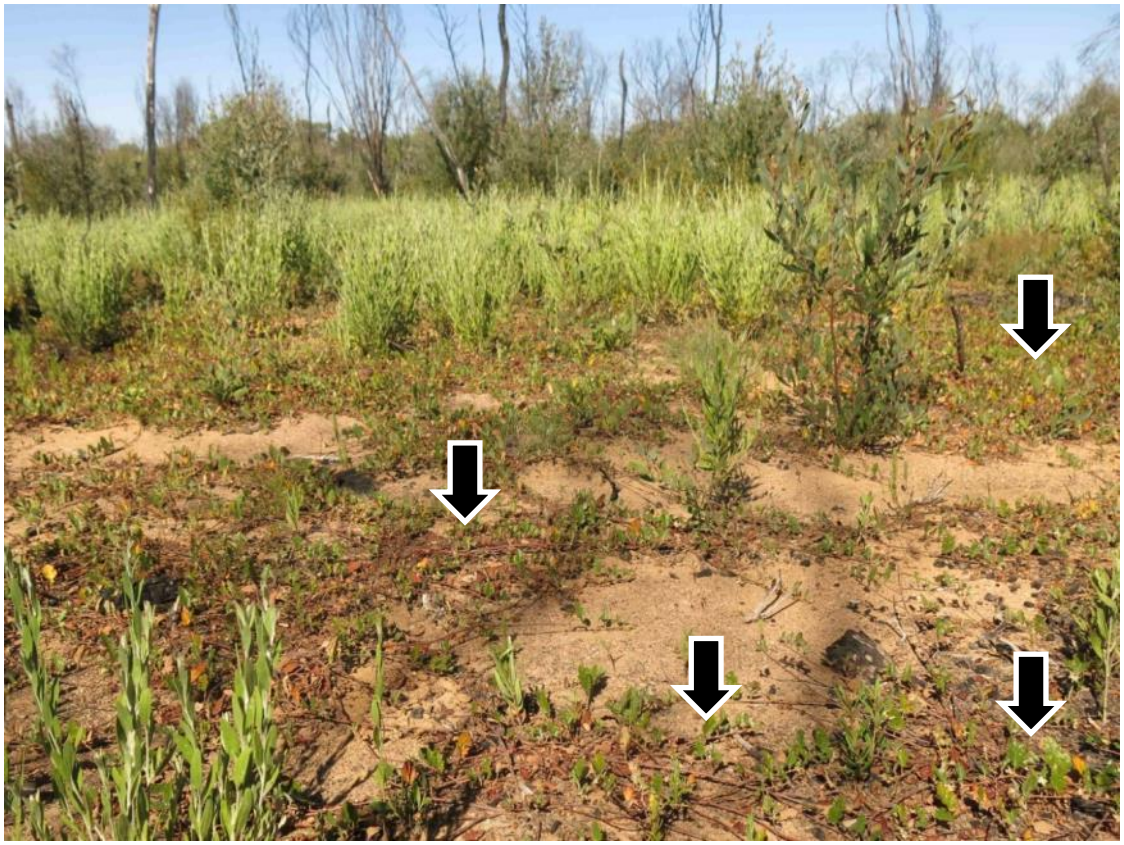


Figure 29: *Commersonia procumbens* dominating the lower ground-layer of heath burnt in a hazard reduction burn in 2015, part of a transect perpendicular to Broom Road made during the AWC flora survey in December 2016 to assess abundance of the species. Photo by AWC.

***Tylophora linearis*, vulnerable BC Act, endangered EPBC Act**

This inconspicuous twiner is sparsely distributed, and flowers and fruits sporadically and then dies back to a tuber (OEH, 2017d). AWC confirmed its presence along the proposed fenceline and management trail in several scattered locations and opportunistically at various other sites in the study area (Figure 30). The AWC records were not restricted to any particular vegetation types in this area, though presence of shrubs to climb on is probably an important factor. Discovery of many new populations of this taxon (Forster et al., 2004) subsequent to its original NSW status listing as Endangered, led to its downgrading to Vulnerable (OEH, 2017d). However, it remains Endangered under the EPBC Act (SPRAT, 2017). Figure 31 shows locations confirmed by AWC botanists, and records from BioNET.

Figure 30: *Tylophora linearis* found by AWC botanists in December 2016. Photo by AWC.

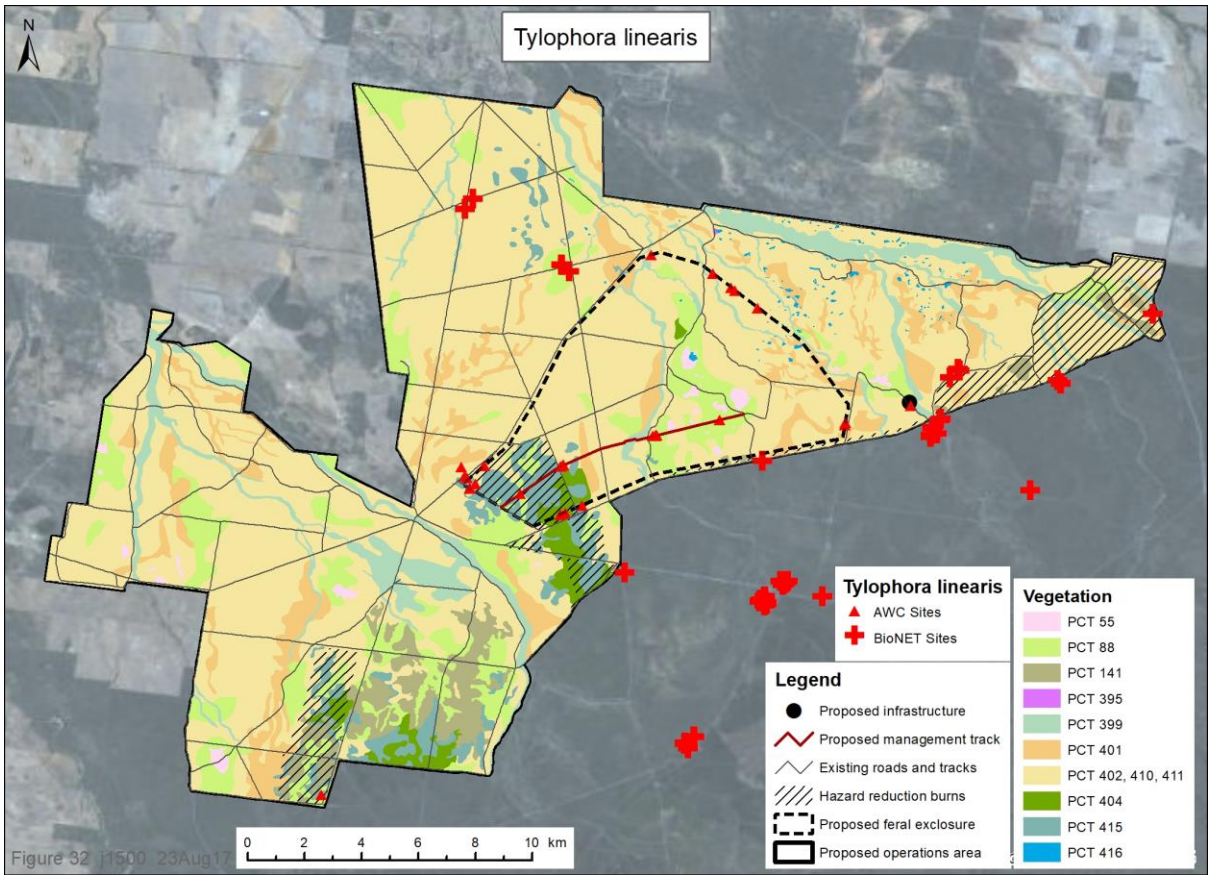


Figure 31**:** *Tylophora linearis* locations from AWC surveys along the proposed fenceline and management trail and from NSW BioNet extracted December 2016

Given the apparent randomness of its occurrence (i.e. occurring in several widespread vegetation types ranging from shrubby to sparse shrubs), AWC consider there is likely to be at least many hundreds and probably more than 1,000 individual plants of *Tylophora linearis* throughout the proposal area.

Other information supports the estimate of many hundreds of plants in the locality:

- ELA (2014) conducted specific surveys to locate *Tylophora linearis* in an area of the Pilliga about 30 km to the east-south-east and found many individuals (a total of 402 in the project area) (ELA, 2014);
- many other BioNET records surround the AWC managed area (OEH, 2017b).

The fenceline and management trail, wherever they are placed, will likely result in the loss of some individuals, although the number is unlikely to be ecologically significant given the size of the local population.

Myriophyllum implicatum, critically endangered BC Act

Several individuals of the *Myriophyllum* genus were found near or along the proposed fenceline by AWC botanists. Ten specimens (including pressed and spirit material and photos) were sent to the National Herbarium of NSW, Royal Botanic Gardens for identification. Four specimens at two locations were confirmed as *Myriophyllum implicatum* (Figure 32). These occurred on one large well-developed wetland inside the proposed fence on the eastern side, and the other was in the Pilliga National Park north-east of the proposed fence (Figure 33, Figure 34). All other *Myriophyllum* encountered were found to be the similar *Myriophyllum simulans,* a common species.

The proposed fenceline and management trail routes were selected to avoid wetlands and the nearest known plants are more than 100 m from the fenceline. No known individual plants would be directly impacted. There are likely to be considerable benefits to this species following implementation of AWC management as the wetlands will be protected from pig damage which is recognised as a threat to this plant (OEH, 2017d).

Figure 32: Female (left) and male (right) plants of *Myriophyllum implicatum*, collected in December 2016 from an ephemeral wetland just inside the proposed conservation fence (Figure 34). Photo by AWC.

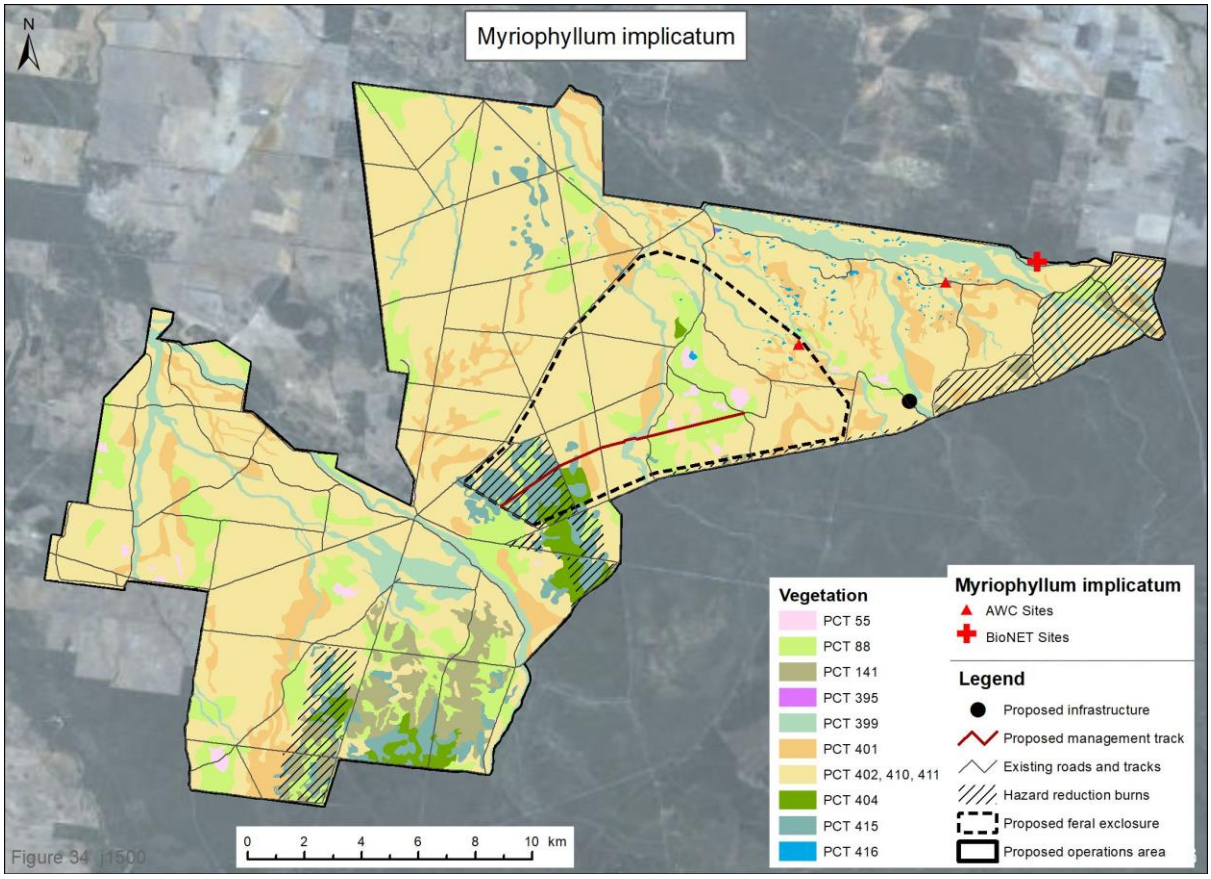


Figure 33**:** *Myriophyllum implicatum* locations from AWC surveys along the proposed fenceline and management trail and from the BioNET database extracted in December 2016. See Figure 34 for close up map of the AWC record from near the proposed fence.

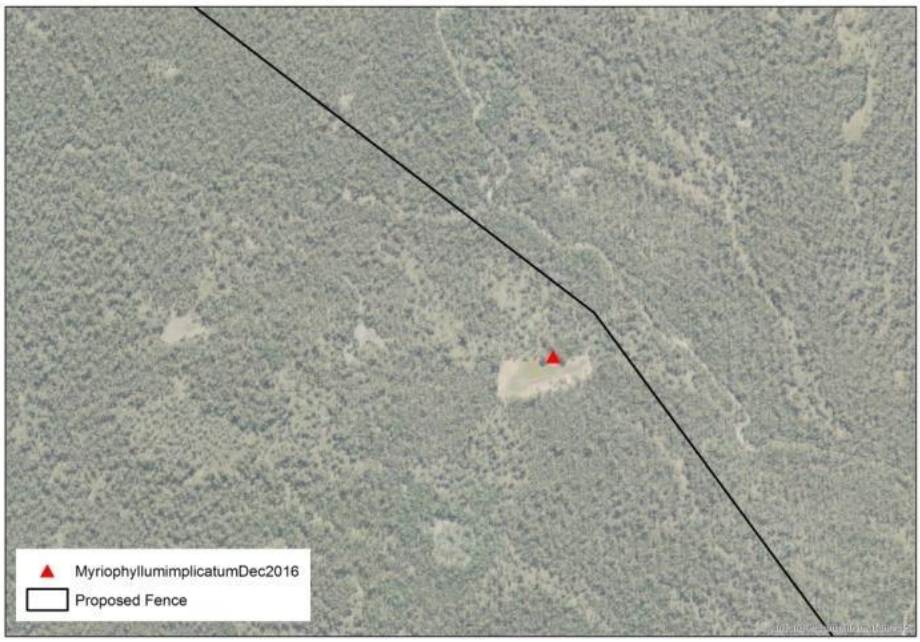


Figure 34**:** Larger scale image showing the location of *Myriophyllum implicatum* close to the proposed fence (AWC December 2016 survey - three specimens collected here).

Pilliga Outwash Ephemeral Wetlands in the Brigalow Belt South Bioregion Threatened Ecological Community

The BC Act lists 'Pilliga Outwash Ephemeral Wetlands in the Brigalow Belt South Bioregion TEC' as endangered. This TEC equates to the 'Tank Herbfields (Gilgai)' vegetation class of Hunter (2010) and PCT 416 (Pilliga tank gilgai wetland sedgeland rushland, Brigalow Belt South Bioregion, OEH (2017c)).

The PMST reported six TECs with EPBC listing (Appendix 2). None of these has been identified within the vicinity of the proposed activity (Appendix 8).

Field surveys undertaken by AWC botanists along the proposed fenceline (more than 10 m either side) and at the operations base location identified the presence of 13 "herbfield or shallow basin wetlands" within the vicinity of the proposal (Figure 35). This is 4% of the 340 Pilliga Outwash Wetlands known to occur in the Pilliga (Bell et al., 2012). The largest is 200 m by 140 m, while most are much smaller. Threats listed for this TEC include disturbance to the ground surface by feral pigs, sedimentation resulting from erosion, grazing by cattle and horses, management trail construction and native vegetation clearing (OEH, 2017d). The proposed route of the fence purposely avoids this TEC.

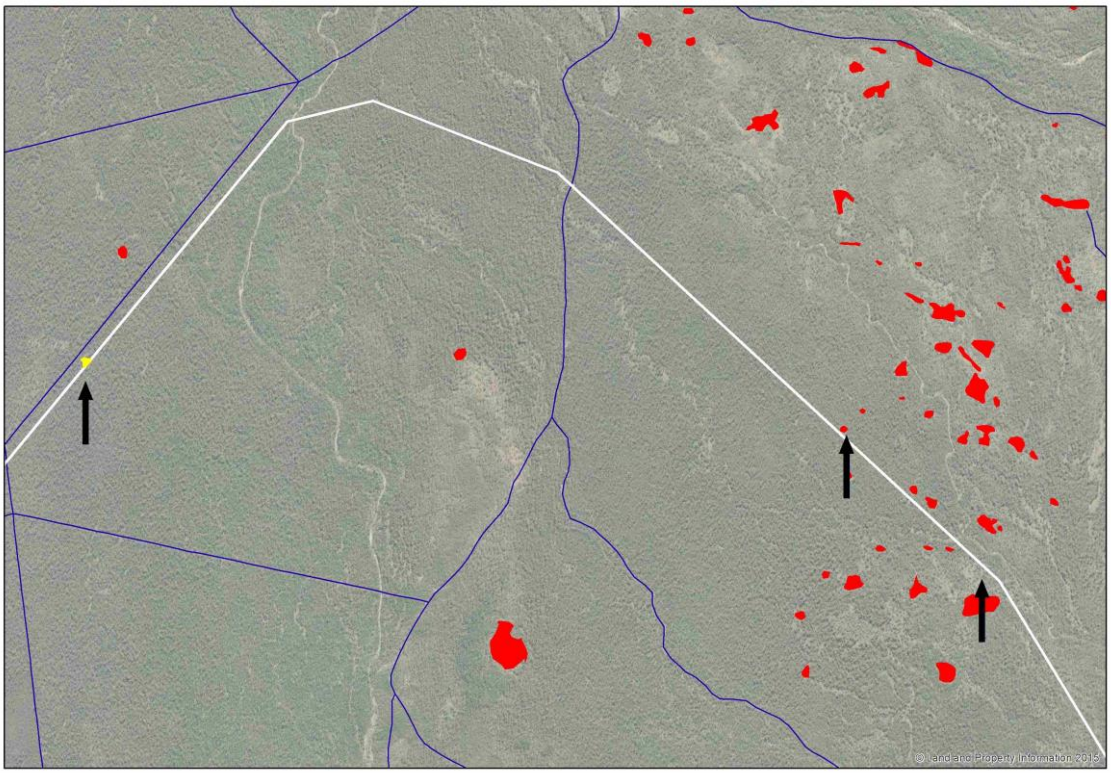


Figure 35: Pilliga Outwash Ephemeral Wetlands TEC in the vicinity of the proposed fenceline. Proposed fence shown in white, roads in blue, Pilliga Outwash Ephemeral Wetlands TEC in red (from Bell et al. 2012) and one in yellow (from AWC on-ground inspection). Black arrows show three areas which may require additional fence alignment considerations.

5.8.4.2 *Fauna and their habitats*

Species Richness

The AWC field surveys in spring 2016 recorded a total of 125 species. These comprised:

- 105 species of bird,
- 11 species of mammal, and
- 9 introduced species.

Surveys for small mammals, reptiles and amphibians were undertaken in autumn 2017 although data are still being analysed.

A full list of the fauna detected during the AWC field surveys to date is provided in Appendix 5.

Fauna habitats

Pilliga SCA and Pilliga NP provide significant habitat for 24 threatened fauna species including the Glossy Black-Cockatoo (*Calyptorhynchus lathami*), Turquoise Parrot (*Neophema pulchella*), Barking Owl (*Ninox connivens*), Corben's Long-eared Bat (*Nyctophilus corbeni*), Koala (*Phascolarctos cinereus*), Pale-headed Snake (*Hoplocephalus bitorquatus*) and Pilliga Mouse (*Pseudomys pilligaensis*). The parks also support species of regional conservation significance including declining woodland birds and endemic invertebrates.

Habitat types for fauna in this REF are descriptive and conceptual accounts that are only loosely-based on the Hunter (2010) and PCT vegetation community classifications, and as such may include several vegetation types. They also incorporate additional information about vegetation structure and available habitat resources in each community (Table 9). On that basis, AWC ecologists identified seven structural and floristic habitat types within the vicinity of the proposal: Grassy Woodland; Herbfields and Wetlands; Riparian Woodlands; Open Forest; Shrubland and Heathland; Shrub and Heath Woodland; and Dense Forest.

Grassy Woodland

The occurrence of understory grasses is widely believed to have declined throughout the Pilliga over the last 200 years. Prior to intensive forestry in the Pilliga, canopy cover was likely sparser, with greater grass cover present between trees. Grassy woodlands are commonly found on dark grey brown to light brown clay loams, sandy clay loams or white sand. Soils are deep to well drained and generally form open depressions on lower slopes. Grassy woodlands are associated with low lying creeks and the immediate flood prone sandy areas beside these creeks. It is estimated that around 18,000 ha of this habitat still exists in remnants in the northern wheatbelt (Cox et al., 2001).

Grassy woodland habitats are predominantly open, with sparse canopy cover encouraging a productive understorey grass layer. However, these communities have experienced extensive disturbance in the Pilliga forest that has resulted in changes to their structure and composition (Figure 36). In areas of cleared grassy woodland that were dominated by *Eucalyptus populnea,* the woody understorey taxa recover rapidly to form thickets. This may also occur after periods of heavy rain or fire (Neldner, 1984). Although grassy woodlands share many dominant tree species with open woodland habitats, the presence of thick grasses in the understorey is a key differentiating feature. The structure of grassy woodland is variable with fluctuating densities of mid-storey plants. Grasses provide important foraging resources (seeds, pollen and nectar) for a range of woodland birds, small mammals and reptiles. Thick tussocks also provide cover from predators. Grassy woodland is the preferred habitat for Rufous Bettong which has not been recorded in the vicinity of the proposal within the last 20 years, but has the potential to occur based on historic records.

Only two hectares of open grassland, identified by Hunter (2010) as ‘C10 Five Minute – Curly Windmill Grass’ (PCT 395), are mapped in the vicinity of the proposal.

Figure 36: Example of Grassy Woodland habitat. Photo by Wayne Lawler (AWC)

Herbfields and Wetlands

Herbfields and Wetlands are found on open and closed depressions with wet and deep light grey sandy loam soils. Water bodies in the vicinity of the proposal consist mainly of artificial man-made dams. Some permanent waterholes are scattered throughout Coghill Creek in the Gilgai section of Pilliga National Park, but no permanent standing water is present within the proposed CFAI.

Freshwater resources are largely ephemeral in nature and based around decadal flooding cycles. During storm events, creek beds flow and pools of standing water occur in small topographic depressions. However, due to the sandy soils present across the study area, these ephemeral pools are relatively short-lived.

Gilgai Wetlands are ephemeral pools often found in shallow topographic depressions (Figure 37). These features are endemic to the EMA project region and are associated with a range of unique and threatened flora and fauna, including the creeping matted-herb, *Myriophyllum implicatum* and the Pale-headed snake, *Hoplocephalus bitorquatus*. It is estimated that over 100 tank gilgais occur within the northern Pilliga forest and adjoining private land (Benson, 2006, Benson et al., 2006).

Figure 37: Example of gilgai wetland habitat. Photo by Viyanna Leo (AWC)

Riparian Woodland

Riparian Woodlands occur on open depressions and also on lower slopes and flats. Soils are deep and usually well drained and are primarily sandy or at times loamy sand, sandy loam or loam. In the study area, this habitat is characterised by the presence of large old-growth Rough-barked Apple (*Angophora floribunda*) and Red Gums (*Eucalyptus blakelyi, Eucalyptus camaldulensis, Eucalyptus chloroclada*) (Figure 38). Within the EMA project area, the largest area of riparian woodland is found along Coghill Creek, which runs through the Gilgai section of Pilliga National Park. Within the proposed CFAI, the largest extent of Riparian Woodland is found along Rocky Creek.

Riparian Woodland habitat provides a wide range of foraging (seeds, pollen, nectar) and shelter (logs, tussocks, shrubs, tree hollows) resources for fauna. The heterogeneity of niches and available micro-habitats within this habitat type (e.g. abundant large tree hollows, dead wood and hollow logs) indicate that reptile, amphibian, mammal and bird species richness is likely to be higher in this community than in surrounding woodland habitats. Canopy and mid-storey structures are suitable for perching and nesting. Hollow-bearing trees, decorticating and fallen bark, logs and fallen branches all provide suitable nesting and foraging substrates for a range of fauna.

Riparian woodlands provide essential habitat and drought refuges for Koalas and Barking Owls in the EMA project area. Large hollow-bearing riparian trees are important system components for Barking Owls (NPWS, 2003, Schedvin et al., 2001, Shelly, 2006), which nest in large, tree hollows in mature Ironbark, Box and Red Gum trees. Riparian habitat provides a suite of preferred food trees (Red Gums) for Koalas (DECC, 2008a).

Riparian woodlands have been modified extensively across their range by grazing and logging (Helman and Estella, 1983). Changes in flooding regimes due to river regulation has led to a decline in recruitment and the quality of the stands of riparian forests and woodlands in many areas (Porteners, 1993).

Figure 38: Example of Riparian Woodland habitat. Photo by Wayne Lawler (AWC)

Open Forest

Open Forest habitat covers the majority of the project area and comprises several vegetation communities separated by differences in the relative abundance of the main dominant tree species (i.e. White Cypress Pine, Narrow-leaved Ironbark, Pilliga Box and Buloke) (Figure 39). Across the Pilliga forests, this habitat type has been extensively affected by more than a century of logging practices, which has led to a homogenisation of age-classes, thick regeneration of White Cypress Pine and Buloke, and a reduction in the number of biological legacies such as large old trees and tree hollows.

Open Forest habitat provides a wide range of foraging (seeds, pollen, nectar) and shelter (logs, tussocks, shrubs, tree hollows) resources for fauna. Canopy and mid-storey structures are suitable for perching and nesting. Hollow-bearing trees, decorticating and fallen bark, logs and fallen branches all provide suitable nesting and foraging substrates for a range of fauna. The dense patches of White Cypress Pine often occurring in open forest habitats are suitable daytime shelter trees for Barking Owls (NPWS, 2003). Mugga Ironbark *Eucalyptus sideroxylon* is present as Open Forest in some parts of the study area, and these are important habitat trees for the migratory Regent Honeyeater (Frankin et al., 1989, Menkhorst et al., 1999), although there are no records of this species occurring in the vicinity of the proposal. Pilliga Box *E. pilligaensis* stands are widespread throughout Open Forest in the vicinity of the proposal and this vegetation community is highly favoured as a food resource for Koalas in the Pilliga (Kavanagh et al., 2007).

Figure 39: Example of Open Forest habitat. Photo by Wayne Lawler (AWC)

Shrubland and Heathland

Heathlands comprising Broombush (*Melaleuca uncinata*), Heath Myrtle (*Micromyrtus sessilis*), Cheel's Westringia (*Westringia cheelii*) and Fringe Myrtle (*Calytrix tetragona*) provide important foraging resource (seeds, nectar, pollen) and thick cover for protection from predators (Figure 40). There are approximately 2,700 ha of heathland within the EMA project area, with approximately 424 ha located within the proposed CFAI. Heath is known to provide important habitat for threatened birds and mammals. The Pilliga Mouse has been recorded in the Shrubland and Heathland habitat present in the EMA project area. Habitat requirements for the Pilliga Mouse are poorly understood and are likely to fluctuate with seasonal conditions (Tokushima and Jarman, 2009).

Figure 40: Example of Shrubland and Heathland habitat. Photo by Wayne Lawler (AWC)

Shrub and Heath Woodland

This habitat type is found on mid to lower slopes on deep sandy loam soils. Shrubby woodlands are restricted to the Pilliga area, but share commonalities with vegetation types found in the surrounding region (Hunter, 2010).

Shrub and Heath Woodlands provide essential foraging resources such as seeds, pollen, nectar, invertebrates and invertebrates. Heterogeneous patterns of heath density and clumps of understorey vegetation provide shelter for ground fauna from predators. Other habitat features such as hollow-bearing trees, decorticating bark, fallen branches and logs present in this habitat type provide important fauna sheltering and foraging substrates.

Diverse and dense shrub layers provide foraging resources for threatened species such as Pilliga Mouse and Eastern Pygmy-possum (Figure 41). Both of these species are known to occur in this habitat type (Bowen and Goldingay, 2000, OEH, 2017d, Paul et al., 2014). The Pilliga Mouse uses the dense cover provided by heath and shrubs to move throughout the forest, which provide protection from predation during foraging and dispersal. The eradication of feral predators from within the fenced area is expected to relax the association of the Pilliga Mouse and other small mammal species with dense cover. Eastern Pygmy-possums are often found in areas which present both tree hollows (commonly in Red Gum species) and high nectar-producing plants such as *Grevillea* spp within close proximity.

Figure 41: Example of Shrub and Heath Woodland habitat. Photo by Wayne Lawler (AWC)

Dense Forest

Dense Forest habitat is found on lower slopes and flats with moist and deep loamy sand, sandy loam and clay loam soils. This habitat type, when characterized by stands of Belah, may be present because of poor drainage, but when it is characterized by dense stems of White Cypress Pine and/or Buloke it is thought to be the result of logging disturbance or other forestry practices in which old trees are removed and fire is excluded. This habitat type is characterised by a dense, low canopy and relatively sparse mid-storey and ground cover (Figure 42). Hollow-abundance is generally lower due to the younger age-class of trees in this habitat type, although standing dead trees and some live trees with large hollows and decorticating bark may be present (Hunter, 2010). This vegetation type is sometimes referred to as “locked-up” forest and, for those areas comprising mainly dense stems of

White Cypress Pine and/or Buloke has been proposed as a candidate for "ecological thinning" to improve its value as habitat for fauna and flora.

The soil substrate is characterised by clay loams, which allow surface water to remain for greater durations than in surrounding habitat types characterised by well-drained sandy soils. These ephemeral pools facilitate amphibian reproduction and serve as a freshwater resource for other fauna. Dense Forest habitat is thought to have reduced species richness because of the more limited range of resources available, however, these dense thickets do provide important shelter for a range of threatened fauna including Black-striped Wallabies. Again, the eradication of feral predators from within the fenced area and their more intensive control outside the fence is expected to relax the requirement of species for dense cover.

Figure 42: Example of Dense Forest habitat. Photo by Wayne Lawler (AWC)

Table 9: PCT vegetation communities and Hunter (2010) classes classified by habitat type, showing differences in key habitat structures

Vegetation community	Habitat type	Tree height (m)	Tree cover (%)	Shrub height (m)	Shrub cover (%)	Understorey height (m)	Understorey cover (%)
PCT 399/397 (C1)	Grassy Woodland	20	40	5	10	1	80
PCT 399 (C2)	Riparian Woodland	12	30	10	40	1	40
PCT 401 (C3)	Open Forest	12	25	2	50	1	30
PCT 141/ 256 (C4)	Shrubland	10	15	8	50	1	15
PCT 415 (C5)	Shrubland	0	0	9	40	1	90

Vegetation community	Habitat type	Tree height (m)	Tree cover (%)	Shrub height (m)	Shrub cover (%)	Understorey height (m)	Understorey cover (%)
PCT 404 (C6)	Shrub or Heath Woodland	14	50	6	30	1	80
PCT 411/410 (C7)	Open Forest, Dense Forest	15	50	8	50	1	60
PCT 411/ 402 (C8)	Open Forest, Dense Forest	14	50	5	30	1	70
PCT 88 (C9)	Open Forest, Dense Forest	40	15	8	60	1	60
PCT 395 (C10)	Grassland or Shrubland	0	0	5	15	0.5	90
PCT 416 (C11)	Herbfield or Wetland	0	0	0	0	1	90
PCT 55 (C12)	Dense Forest	15	60	6	40	1	30

Tree Hollows

Key habitat components within Australian forest ecosystems are hollow-bearing trees (HBTs) which are important for fauna species requiring tree hollows for diurnal shelter and nesting. The protection of HBTs, and the future supply of hollows used as shelter by hollow-dependent fauna, have been identified as important management objectives for the forests and woodlands of southern Australian forests for over four decades (Cowley, 1971, Recher et al., 1987, Lunney et al., 1988, Law, 1996).

As the largest area of continuous forest and woodland west of the Great Dividing Range, the Pilliga presents an important stronghold for hollow-using fauna. Despite a long period of logging that focused on the commercially valuable White Cypress Pine *Callitris glaucophylla* and Narrow-leaved Ironbark *Eucalyptus crebra*, hollow-bearing ironbarks remain a valuable source of hollows throughout the Pilliga. Vegetation types composed of non-commercial species, such as those dominated by box species (particularly Pilliga Box *E. pilligaensis*), and mixed eucalypt forests dominated by red gums (*E. chloroclada*, *E. blakelyi*), Rough-barked Apple *Angophora floribunda* and Brown Bloodwood *Corymbia trachyphloia*, that escaped intensive logging, also provide a valuable source of HBTs.

In February 2017, AWC ecologists conducted detailed surveys for hollow-bearing trees within the proposed 15 m clearing along the entire 32 km fenceline and at the proposed operations base Asset Protection Zone (APZ). This unbiased survey is representative of the distribution of hollow-bearing trees throughout the entire EMA. An HBT was defined as a tree with any observable hollow with an entrance sufficiently large (approx. 2-5 cm in diameter) to provide shelter for small fauna such as *Antechinus* spp or microchiropteran bats. During the survey, the locations, species and diameter at breast height (DBH) of all trees >40 cm DBH and any other trees containing an observable hollow were recorded within 7.5 m either side of the proposed fenceline. Surveys also recorded most hollow-bearing trees within 15 m either side of the proposed fenceline as well as all large-diameter hollow-bearing trees up to 30 m from the fenceline. This information was used to determine whether the alignment could be refined to minimise removal of HBT. The 40 cm DBH size class was chosen because the probability of trees containing a hollow suitable for wildlife increases markedly above 40 cm DBH (Kavanagh, Deane et al. unpublished data).

In the AWC survey, 2,952 trees were assessed and mapped. Of these, a total of 978 occurred within 7.5 m of the proposed fenceline. The occurrence of hollows in trees >40 cm DBH within 7.5 m of the Pilliga fence is shown in Figure 43. The figure shows that the proportion of trees containing at least one small hollow increased with DBH. About half the trees 40-60 cm DBH have at least one hollow, whereas most trees larger than 60 cm DBH have at least one hollow and nearly all trees larger than 80 cm DBH had at least one hollow.

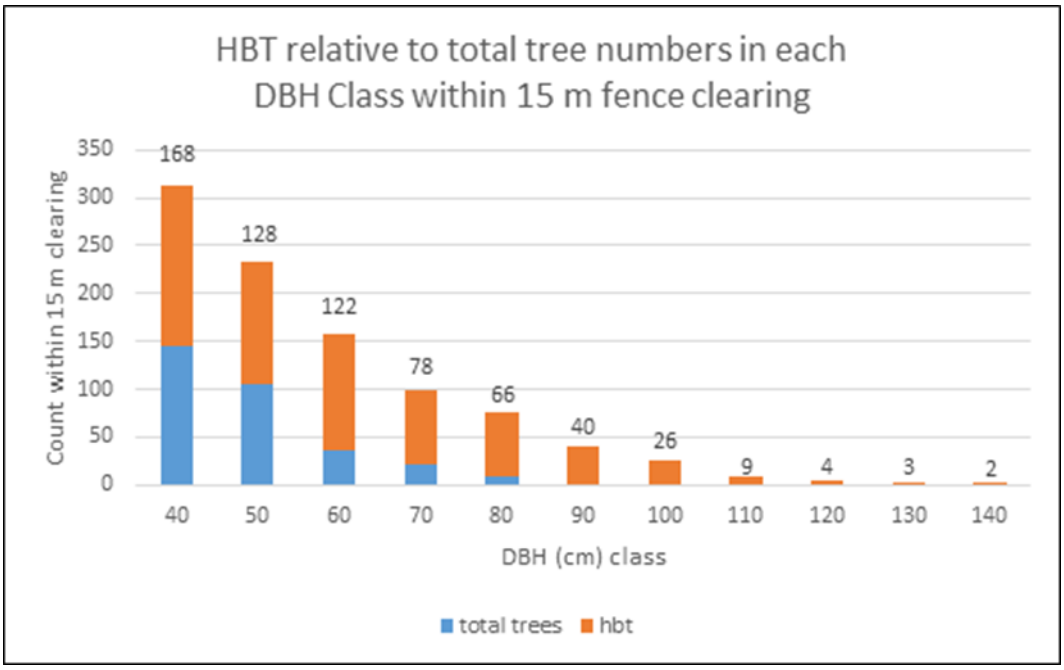


Figure 43: Distribution of hollow-bearing trees (hbt or HBT) by diameter size-class within 7.5 m of the conservation fence alignment in the Pilliga. Hollow-bearing trees shaded brown. The total number of trees recorded in each size-class is shown by the vertical axis.

The total number of trees >40 cm DBH and the number of these trees with hollows found in each vegetation community within the areas likely to be affected by clearing for the proposed conservation fence, the operation base and new management trail are shown in Table 10, Table 11 and Table 12. These data show that:

- approximately 659 hollow bearing trees of more than >40 cm DBH may be removed from the proposed fenceline;

- approximately 162 hollow bearing trees of >40 cm DBH may be removed from the proposed operations base;
- approximately 37 hollow bearing trees of >40 cm DBH may be removed from the route of the proposed new management trail.

Table 10: Total number of hollow-bearing trees (HBTs) recorded within 7.5 m either side of the proposed conservation fence, by vegetation community

Vegetation community	Total area within 15 m fence clearing (ha)	Number of hollow-bearing trees	Mean number of visible hollows
PCT 411/410	24.4	362	1.37
PCT 411/402	8.98	154	1.64
PCT 401	5.13	81	1.41
PCT 88	2.06	29	1.79
PCT 404	1.84	14	1.81
PCT 415	4.32	12	1.06
PCT 399	0.58	7	1.38
PCT 141/256	0.81	0	0.00
Total	48.13	659	1.46

Table 11: Total number of hollow-bearing trees (HBTs) recorded within the 75 m Asset Protection Zone surrounding, and inclusive of, the proposed operations base, by vegetation community

Vegetation community	Total area within operations base 75 m APZ (ha)	Number of hollow-bearing trees	Mean number of visible hollows
PCT 411/402	8.1	94	1.24
PCT 88	2.0	26	1.49
PCT 399	0.2	3	0.64
Total	10.3	123	1.12

Table 12: Total number of hollow-bearing trees (HBTs) estimated to be along the route of the proposed new management trail, based on number per hectare of the same PCT along the route of the fenceline

Vegetation community	Area along new trail (ha)	Estimated number of hollow-bearing trees
PCT 411/410	0.95	14
PCT 411/402	0.09	2
PCT 88	1.05	15
PCT 415	0.89	2
PCT 401	0.10	2
PCT 399	0.16	2
PCT 404	0	0
PCT 399/397	0	0
PCT 55	0.03	0
PCT 416	0	0
PCT 141/256	0	0
PCT 395	0	0
Total	3.27	37

Impacts of proposed clearing on occurrence of hollow-bearing trees in the proposal area

The proposed fenceline traverses a representative sample of the vegetation found in the EMA project area: the most common vegetation types in the EMA project area (Table 6) are also the main vegetation types to be affected by the proposed fenceline clearing (Table 10). That is, the proposed fenceline is effectively a sample of the EMA project area, and hence the results of the survey of HBTs in the vicinity of the fenceline can be extrapolated to estimate the occurrence of HBTs across the project area.

The survey found that HBTs (as defined) were ubiquitous and abundant in the EMA project and the proposal areas. Even trees larger than 80 cm DBH, which have a very high likelihood of containing hollows, are widely distributed throughout the Pilliga forests (Figure 44). Based on the results of the survey, the proposed loss of about 820 HBTs represents less than 0.8% of the total HBTs estimated to occur in the proposal area. On this basis, the loss of hollows as a result of the proposal is not environmentally significant.

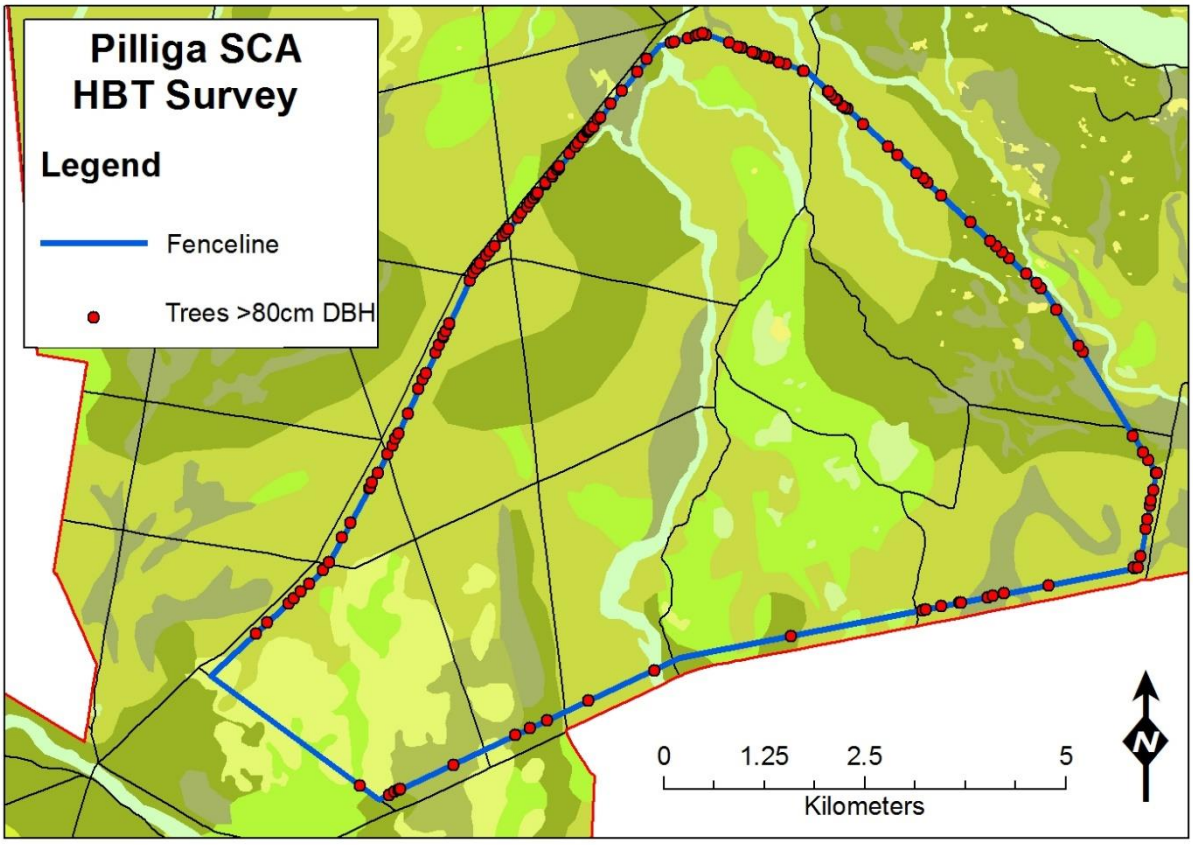


Figure 44: Distribution of trees larger than 80 cm DBH along the proposed fence alignment in the Pilliga forests

Mitigation of the proposed clearing on occurrence of hollow-bearing trees

Opportunities to re-align the fenceline to avoid removing hollow-bearing trees are non-existent. This is illustrated by a representative 200 m section of the fence showing the distribution of all trees >40 cm DBH (Figure 45). Moving the fence alignment to either side of the proposed alignment would result in the clearing of other large trees, most of which are also likely to contain hollows. Instead, AWC proposes adopting clearing protocols which minimise the impacts of clearing on fauna using HBTs (Appendix 12).

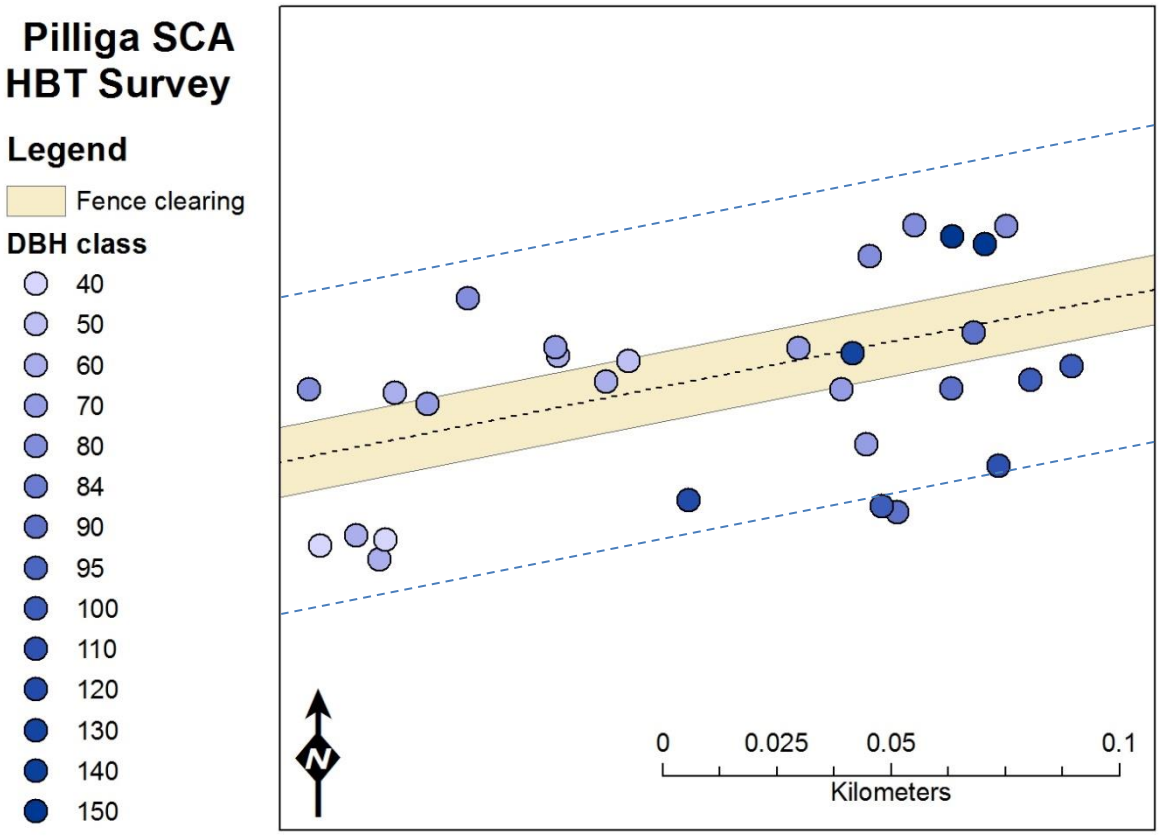


Figure 45: Distribution of all trees larger than 40 cm DBH within a representative 200 m section of the fence alignment. Every tree >40 cm DBH within 7.5 m either side of proposed fenceline (shading) was assessed; large diameter trees or trees with obvious hollows were surveyed up to 30 m (outer dashed lines) of proposed fenceline.

Biological Legacies

Fallen timber, large bark strips, hollow-bearing logs, dense layers of leaf litter and other features can provide essential habitat for ground and fossorial mammals, reptiles, birds and invertebrates. These habitat features form over long periods of time in the absence of major disturbances such as logging and large-scale high-intensity wildfires. As such, they are commonly referred to as 'biological legacies'. Within the fenceline and operations base clearings, there is likely to be a loss of such features. However, given the abundance of these features across the landscape and the minimal area to be cleared, there is likely to be little adverse impact from the loss of these features on fauna. Additionally, trees which will be felled to clear the fenceline corridor can be placed on the ground to supplement the initial loss of hollow-bearing logs and dense litter cover. These new logs will degrade over time, providing habitat for ground-dwelling fauna.

Threatened Fauna

A total of 17 threatened fauna species were confirmed as present in the Pilliga SCA and Pilliga NP (Gilgai section) during the spring 2016 and autumn 2017 surveys by AWC. Birds were recorded during formal bird surveys, except for Barking Owls and Bush Stone-curlews which were recorded during spotlighting surveys. Koalas were only recorded during spotlighting surveys, and Black-striped Wallabies only by motion-activated cameras.

The 17 confirmed threatened fauna species are:

- Barking Owl, vulnerable BC Act
- Brown Treecreeper (eastern subspecies), vulnerable BC Act
- Bush Stone-curlew, endangered BC Act
- Dusky Woodswallow, vulnerable BC Act
- Eastern Pygmy-possum, vulnerable BC Act
- Glossy Black-Cockatoo, vulnerable BC Act
- Grey-crowned Babbler (eastern subspecies), vulnerable BC Act
- Little Lorikeet, vulnerable BC Act
- Little Eagle, vulnerable BC Act
- Pilliga Mouse, vulnerable BC Act, vulnerable EPBC Act
- Scarlet Robin, vulnerable BC Act
- Speckled Warbler, vulnerable BC Act
- Superb Parrot, vulnerable BC Act, vulnerable EPBC Act
- Turquoise Parrot, vulnerable BC Act
- Varied Sittella, vulnerable BC Act
- Black-striped Wallaby, endangered BC Act
- Koala, vulnerable BC Act, vulnerable EPBC Act

Black-striped Wallabies were only recorded by cameras located on monitoring sites and records of this species were distributed across the surveyed area. All other species for which multiple records exists were also distributed across the survey area. However, the Little Lorikeet was only recorded in the central part of the proposed fenced area.

The locations of threatened bird species recorded by AWC during the 2016 field surveys are shown in Figure 46 and for other threatened species in Figure 47.

The number of observations and relative abundance are recorded in Table 13.

Table 13: Threatened bird and mammal species observed during the spring 2016 and autumn 2017 surveys conducted in Pilliga SCA and Pilliga National Park (Gilgai section), with their EPBC (Environment Protection and Biodiversity Conservation Act 1999) and BC (Biodiversity Conservation Act 2016) threatened status, and with total observations and relative abundances (* diurnal bird records per total counts, n=180; ^ sightings per kilometre of spotlighting transect, n=48; ~ sightings per camera trap-night, n=840).

Species	EPBC	BC	Observations	Relative Abundance
Little Lorikeet (*Glossopsitta pusilla*)		Vulnerable	27	0.150
Scarlet Robin (*Petroica boodang*)		Vulnerable	2	0.011
Glossy Black-Cockatoo (*Calyptorhynchus lathami lathami*)		Vulnerable	1	0.006
Speckled Warbler (*Chthonicola sagittata*)		Vulnerable	46	0.256
Superb Parrot (*Polytelis swainsonii*)	Vulnerable	Vulnerable	6	0.033

Species	EPBC	BC	Observations	Relative Abundance
Turquoise Parrot (*Neophema pulchella*)		Vulnerable	1	0.006
Varied Sittella (*Dapoenositta chrysopters*)		Vulnerable	37	0.206
Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)		Vulnerable	13	0.072
Brown Treecreeper (*Climacteris picumnus victoriae*)		Vulnerable	21	0.117
Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)		Vulnerable	34	0.189
Bush Stone-curlew (*Burhinus grallarius*)		Endangered	3	0.010
Barking Owl (*Ninox connivens connivens*)		Vulnerable	50	0.167
Little Eagle (*Hieraaetus morphnoides*)		Vulnerable	Not yet analysed	
Black-striped Wallaby (*Macropus dorsalis*)		Endangered	28	0.029
Koala (Qld, NSW, ACT) (*Pascolarctos cinereus*)	Vulnerable	Vulnerable	6	0.033
Eastern Pygmy-possum *(Cercartetus nanus)*		Vulnerable	Not yet analysed	
Pilliga Mouse (*Pseudomys pilligaensis*)	Vulnerable	Vulnerable	Not yet analysed	

The potential for other threatened fauna species to occur within the vicinity of the proposed CFAI has been assessed in the threatened and migratory biota evaluations (Appendices 6 and 8).

5.8.5 Assessment of affected species

Affected species are those considered to have some potential to be impacted by the proposal as they are known to either occur within the study area, or have a high potential to occur within the study area based on available habitat. Affected species are identified in the threatened and migratory biota assessments in Appendices 6 and 8, and are the subject of detailed impact assessments (Significance Assessments, Appendices 7 and 8).

5.8.6 Impact assessment

This REF provides a detailed assessment of the anticipated potential direct and indirect impacts of the proposal. This REF includes a range of recommended impact amelioration measures designed specifically to mitigate any adverse effect of the proposal on threatened and migratory biota.

This REF assumes that the amelioration measures detailed would be fully implemented should the proposal be approved.

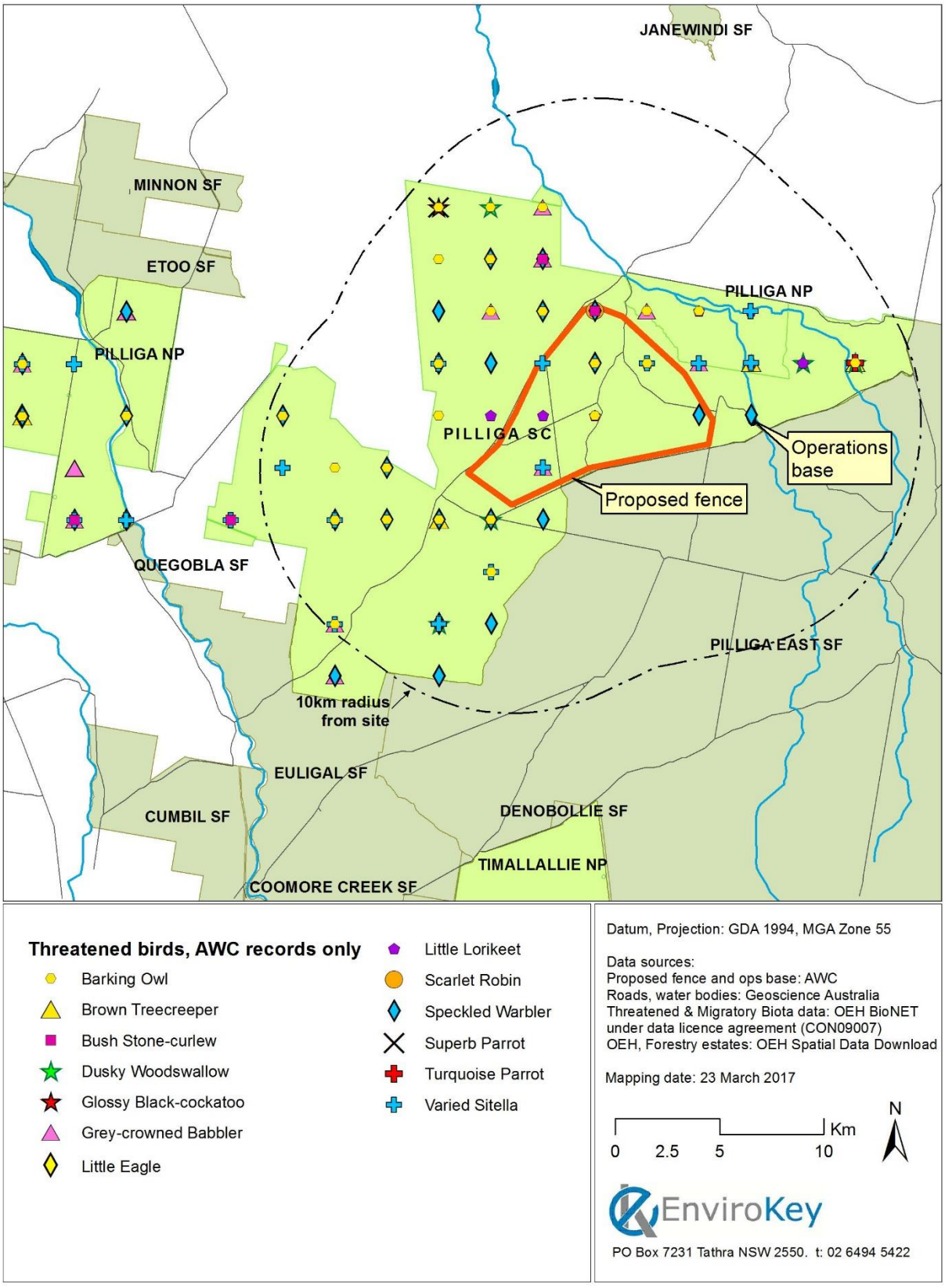


Figure 46: Locations of threatened birds recorded by AWC during the spring 2016 field surveys

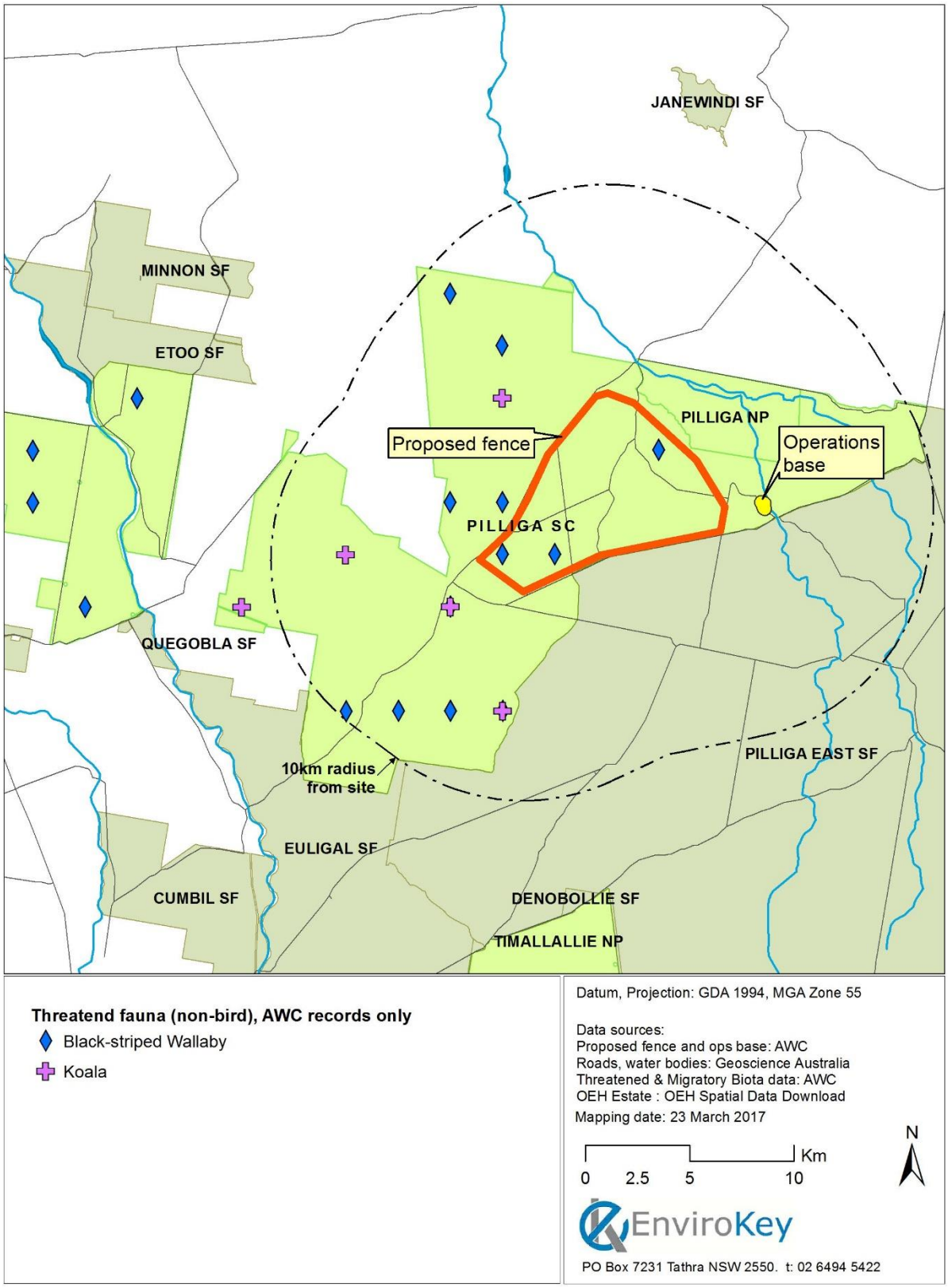


Figure 47: Locations of other threatened fauna (non-bird) recorded by AWC during the spring 2016 field survey

5.9 AREAS OF OUTSTANDING BIODIVERSITY VALUE

No areas of outstanding biodiversity value as listed under the BC Act occur within the study area. Therefore, these will not be affected.

5.10 WILDERNESS (NOMINATED OR DECLARED)

There is no area of wilderness (nominated or declared) within or adjoining the study area. Therefore, the proposal will not affect any area of wilderness.

5.11 HISTORIC HERITAGE

Searches of relevant databases (Protected Matters Search Tool, NSW State Heritage Register and Australian Heritage Database), Narrabri LEP and information obtained from NPWS by AWC, revealed a number of heritage items in the vicinity of the proposal. These include:

- Pilliga dog-proof fence
- Survey marker trees
- Old telephone line pole
- Sleeper cutter camps
- Grave sites
- Pilliga Nature Reserve (Register National Estate), and
- Pilliga Indigenous Place (to be assessed in the Aboriginal Cultural Heritage report, Appendix 11).

These sites include Ironbarks Crossing mill site, Rocky Creek mill site and Sutherlands Well. The heritage database searches conducted for this REF are provided in Appendices 2, 9 and 10. The locations of historic heritage in the study area are shown Figure 48.

The proposed works will not impact the historic heritage sites. The historic grave site, located off Bens Road along the north west corner of the planned fence is at least 50 m from the fence alignment. This site has been recorded on maps and will be avoided during works associated with the fence development.

The historic sites within the proposed fenced area will not be impacted by either the fence construction or the development of the new internal management trail. These sites have also been recorded on planning maps and will be avoided during the course of operations. Planned operations in the vicinity of these sites include feral animal control, weed management and scientific activities including wildlife reintroductions. It is not anticipated that any of these activities will negatively impact these sites.

The preparation of the Cultural Heritage Assessment identified further sites that may be of historic value (see Appendix 11, section 6.3.4). The proposed works do not impact these sites. A report, separate to this REF, will be provided to OEH for further consideration in relation to management and interpretation of these sites.

5.12 ABORIGINAL CULTURAL HERITAGE

AWC engaged Onsite Cultural Heritage Management (OCHM) to prepare an Aboriginal Cultural Heritage Assessment report in relation to the proposal. The study carried out by OCHM did not include the route of the proposed new management trail inside the fenced area. This route was assessed by Craig Trindall Consulting Pty Ltd. Final reports for both investigations have been prepared, and locations of items identified within the vicinity of the

proposal are shown in Figure 49 and Figure 50. Both reports are appended to this REF (Appendix 11).

The assessment reports have been prepared in accordance with the OEH *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011) and the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (OEH, 2010).

The assessment reports detail a process of Aboriginal community consultation in accordance with the *Aboriginal cultural heritage consultation requirements for proponents* (DECCW, 2010).

The OCHM survey located three sites (identified as PF1, PF 2 and PF3 within the attached report). PF1 and PF2 are located where Rocky Creek crosses Railway Survey Road, 15 m from the planned fenceline. The planned works do not impact these sites.

PF3 is located at the intersection of Bens Road and County Line Road, approximately 15 m from the planned fenceline. The planned work does not impact this site.

There were no sites recorded within the planned operations base site.

The survey of the proposed new management trail identified one culturally modified tree within its vicinity. Impacts on this tree will be avoided by diverting the proposed management trail around it with a buffer of at least 10 m.

5.12.1 Stopwork procedure

Given the long history of usage within the Pilliga forest, and the Pilliga State Conservation Area, there is potential for further sites to be discovered whilst undertaking science and land management activities throughout the SCA. Should a suspected Aboriginal Heritage Site be discovered, the following protocol will be applied:

- Works will immediately cease.
- Photographs will be taken of the site, along with any other relevant recording data such as GPS coordinates.
- The perimeter will be, as far as is practicable, flagged with marking tape and all staff and other personnel working in the area notified of the site and instructed to not disturb the site.
- NPWS staff will be advised.
- The relevant Local Aboriginal Land Council (nominally, either the Narrabri, Pilliga or Wee Waa LALCs) will be contacted, and engaged to assess the site and provide advice on management.

Should the site be of significance, OEH and NPWS will be notified in writing for the records to be entered into the database for the Pilliga SCA. The site will be added to work plans to ensure no disturbance.

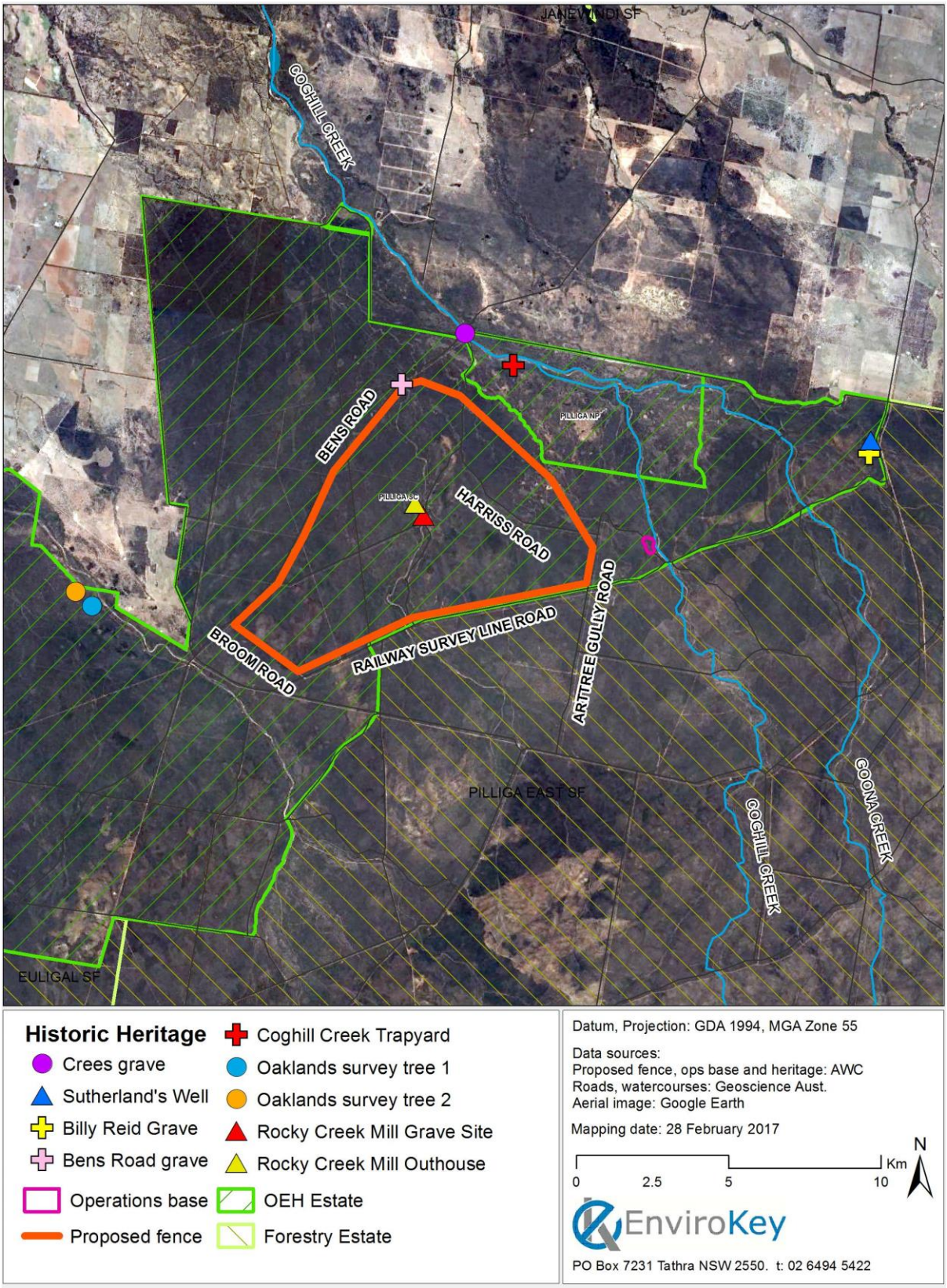


Figure 48: Locations of historic heritage sites in the vicinity of the proposal

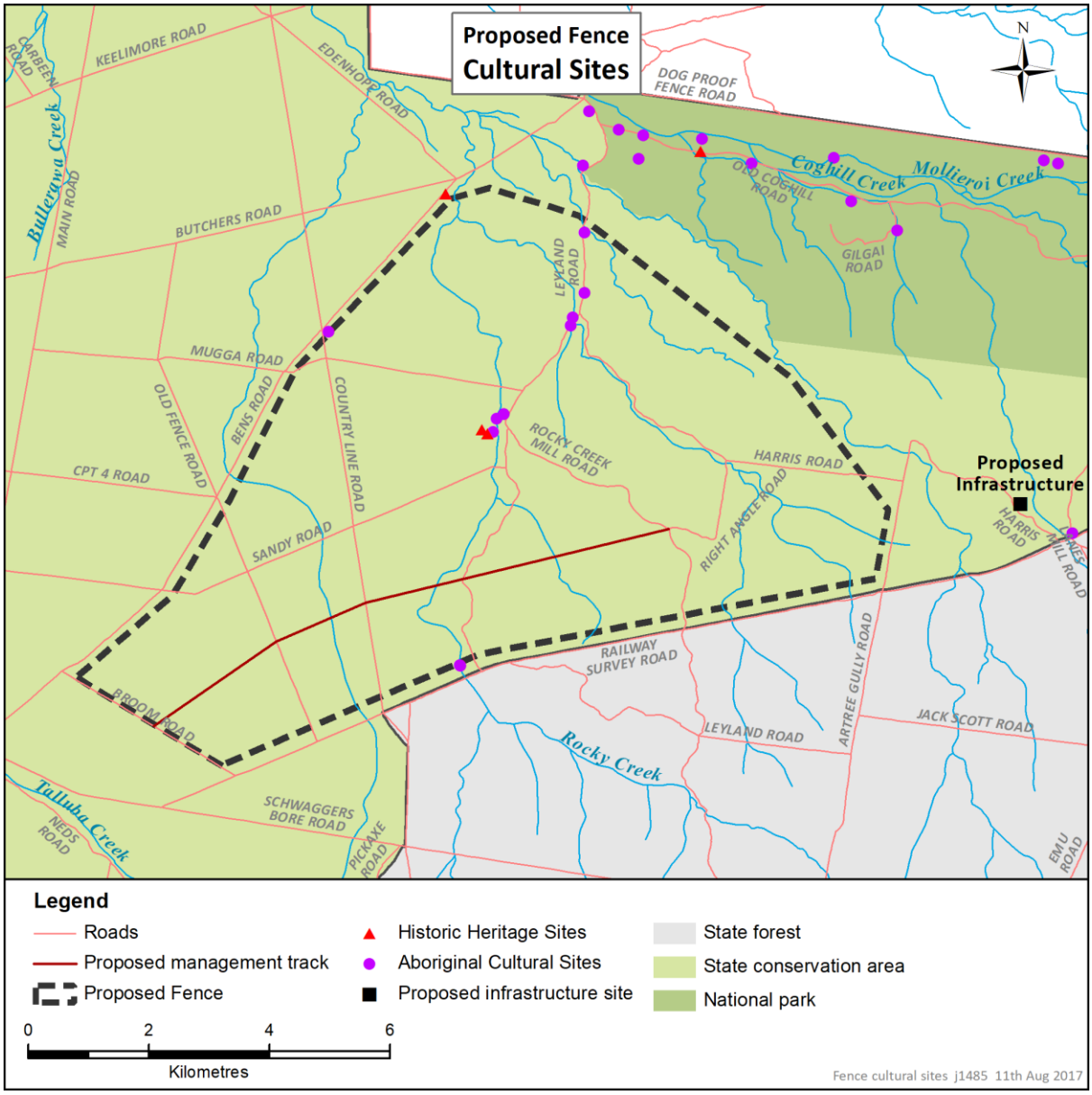


Figure 49: Cultural heritage survey results in the vicinity of the proposal (see also Figure 50)

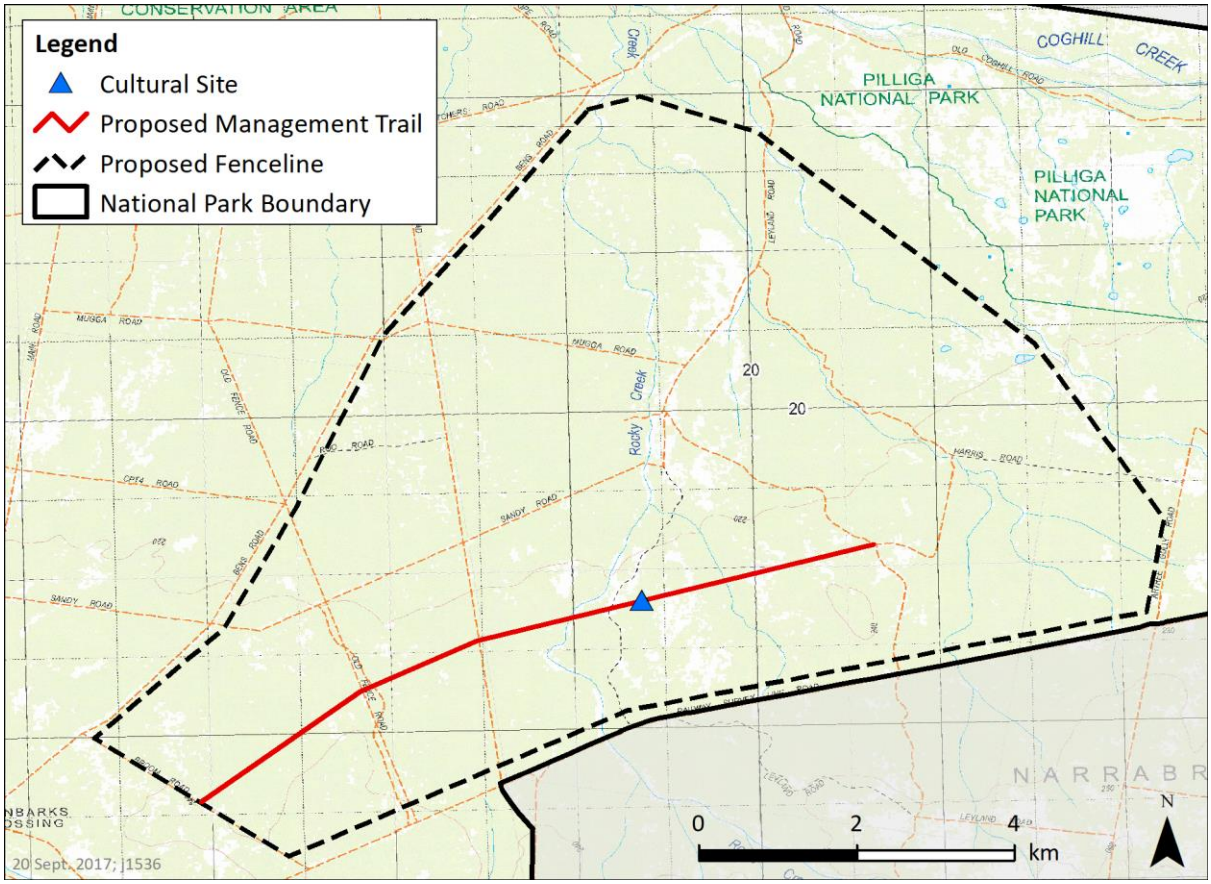


Figure 50: The location of the Aboriginal cultural heritage site identified in the vicinity of the proposed new management trail

5.13 RECREATION VALUES

Pilliga SCA is land reserved under the NP&W Act which encompasses 33,386 ha; however, it has a low level of visitation (OEH, 2014). Recreational driving and self-reliant nature based recreation such as birdwatching and bushwalking are likely the main recreation values of the SCA. There is also a moderate level of unlawful use of the area including hunting.

5.14 SCENIC AND VISUALLY SIGNIFICANT AREAS

The Pilliga forest represents one of the largest areas of forest and woodland in western NSW contributing to the scenic and visual significance of the area. The study area is a small part of the Pilliga forest. The planning for the proposed works has considered the scenic and visual significance of the area, and has mitigated the impact through the following measures.

- Fence development: Two sides of the proposed fenced area are offset between approximately 80 and 120 m from roads (Railway Survey Road and Bens Road). A third side (north east section) will not be visible as there are no significant public access roads. The final side of the fence (Broom Road) represents approximately 2.4 km of the total fence length (or less than 7%) that will be directly visible. The setback from the roads provides a natural vegetation visual barrier.
- Operations base: The access road for the operations base is proposed to be located on Harris Road, 750 m from the intersection with Railway Survey Road. The base

infrastructure will be located along a loop management trail off Harris Road, with buildings sited at least 45 m from Harris Road. Harris Road is a low usage road (by the public) partly given it is a loop road, and not a throughway. The buildings to be sited within the operations base will be only single storey and externally clad in blue/grey colours that will blend into the surrounding natural vegetation.

5.15 EDUCATION AND SCIENTIFIC VALUES

The Pilliga forest has a scientific research record extending over many years although only limited scientific research has been conducted in the proposal area. The SMI actively encourages research which in turn can guide management principles which are based on the results of the research as opposed to anecdotal evidence (NPWS, 2002, OEH, 2014). AWC have begun a program of large-scale, targeted flora and fauna surveys across the SCA and NP with the aim of documenting species presence, and monitoring over-time as part of the EMA. The EHMF to be implemented by AWC (Appendix 13) represents a massive increase in the level of scientific activity in the EMA project area (see Section 4.3.9 above).

5.16 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

The Protected Matters Search Tool (EPBC Act) was utilised to provide a summary of Matters of National Environmental Significance (NES) for a 50 km radius around a central point of the proposed feral predator-free area (Appendix 2). The Protected Matters Search Tool returned the following results:

- No World Heritage Properties,
- No National Heritage Place,
- 3 Wetlands of International Importance,
- Great Barrier Reef Marine Park (not applicable),
- Commonwealth Marine Parks (not applicable),
- 6 Listed Threatened Ecological Communities,
- 30 Listed Threatened species, and
- 8 Listed Migratory Species.

The entities listed within the Protected Matters Report relate to flora and fauna. This REF includes extensive analysis and assessment of threatened ecological communities and listed threatened and migratory species (Appendix 8). The assessments identified that some biota listed under the EPBC Act require consideration in this REF because they may potentially be affected by the proposal. For these biota, significance assessments under the BC Act and under the EPBC Act (if both applicable) are provided in Appendices 7 and 8. The proposal is *unlikely* to have a *significant impact* on any matter of NES in accordance with the Significant Impact Criteria (Appendix 8) (DOTE, 2013).

No other matters of NES are relevant to the proposal. The listed wetlands are located 800 km or more from the proposal and therefore would not be impacted.

The Protected Matters Report is provided in full in Appendix 2.

6 IMPACT ASSESSMENT

6.1 Direct Impacts

6.1.1 Removal of feral predators and herbivores

Feral predators

Feral predators (feral cats and foxes) are considered the primary cause of the extinction of Australia's mammals, and feral cats are rated the primary threat to extant mammal species (Woinarski et al., 2014). Both cats and foxes take a wide range of native species besides mammals, including birds, lizards, frogs and invertebrates. There are millions of feral cats across Australia (Legge et al., 2017) and millions of foxes across the southern two-thirds of Australia (Saunders et al., 2010).

Some threatened native species (especially some small to medium-sized mammals – e.g., Western Barred Bandicoot, which is proposed for reintroduction in the Pilliga) persist only in the complete absence of cats and foxes. At present, there are currently no effective management strategies for eradicating cats and foxes at a landscape scale. The only option for permanently removing feral cats and foxes from part of mainland Australia is the construction of conservation fencing, the eradication of cats and foxes from within the fenced area, and ongoing maintenance of the integrity of the fence (such as the proposal which is the subject of this REF). In other words, for a suite of threatened mammal species, the establishment of large, fenced, feral-free areas is the only effective strategy for delivering a significant recovery in populations.

Some threatened native species can persist in the presence of feral cats and foxes, provided densities of these feral predators are sufficiently low and/ or habitats are sufficiently complex to provide refuge for native animals. However, outside of south-western Australia, there are very few, if any, examples of long-term control of foxes and cats that have driven significant and sustained improvements in threatened fauna populations, especially reintroduced threatened mammals, at a landscape level. In particular, there is no effective strategy for the large-scale eradication of feral cats. The options for fox control at the landscape scale are more effective; however, control of foxes alone is not sufficient for conservation of many threatened species and recent evidence has shown that fox control can result in an increase in the cat population, with adverse consequences for vulnerable wildlife. For example, the recent decline of Brush-tailed Bettongs in south-west Western Australia has been attributed to increased levels of cat predation following long-term fox control (Marlow et al., 2015).

The eradication of feral cats and foxes is therefore an integral component of AWC's plans to reintroduce 'extinct in NSW' mammals as described in this REF. Eradication of feral predators will also benefit extant native species, particularly small to medium-sized mammals, and ground-active birds such as Bush Stone-curlews.

If implemented, the proposal will have a substantial positive impact on native fauna by permanently removing feral cats and foxes from a 5,800 ha area. Many of the fauna species in this area – including threatened species such as the Pilliga Mouse – are currently subject to significant predation by feral cats and foxes. The removal of this predation is likely to result in an increase in the population of these species within the feral predator-free area.

- The density of cats and foxes in the Pilliga is unknown. However, both species were frequently detected in baseline surveys conducted by AWC in 2016/17. Cats were

detected in 9 of 50 cameras set along roads in the Pilliga, and foxes in 42 of 50 cameras set along roads, in autumn 2017.

- The nearest location to the Pilliga where a robust estimate of the density of feral cats and foxes has been obtained is Yathong National Park. At this site, the density of foxes was 2.0/km^2 and feral cats was 0.9/km^2 (Newsome et al. 1989). Extrapolating from this study, there may be 50 cats and over 100 foxes in the 5,800 ha area.
- Both feral cats and foxes are opportunistic, generalist predators (Saunders et al. 2010; Doherty et al. 2015): in the Pilliga, they can be expected to eat native animals (small mammals, reptiles, birds and frogs) and feral animals (rabbits, mice). Feral cats can be expected to be killing and eating in the order of 7 prey items per cat per night (McGregor et al. 2015).
- Assuming native animals make up half the prey of feral cats in the Pilliga, the 50 feral cats may be killing ~150 native animals per night or over 50,000 native animals per year in the 5,800 ha area proposed for fencing.
- Foxes can be assumed to be having a similarly large impact, given their likely density in the Pilliga.
- The permanent exclusion of feral cats and foxes from this area will therefore deliver a very substantial benefit for a large number of extant fauna species.

The implementation of more intensive feral cat and fox control across the balance of the EMA project area will also deliver substantial benefits for a range of extant fauna, although this is more difficult to quantify until the effectiveness of such intensive control can be measured.

Eradication of feral predators has the potential to release small introduced herbivores (rabbits and hares) from some of their main predators. For this reason, AWC will conduct integrated control of feral predators and herbivores within the fenced area.

Feral herbivores

Feral herbivores present within the vicinity of the proposal include feral cattle, horses, goats, sheep, deer, rabbits, hares and pigs. Feral herbivores can have a range of adverse impacts on native species and ecosystems, including:

- a reduction in ground cover of palatable plant species, particularly in heavily utilised areas (productive soils, river flats and other vegetation near water);
- inhibition of the recovery of ground cover on recently burnt sites;
- an increased exposure of ground-dwelling mammals, birds and reptiles to predation by feral predators (McGregor et al., 2014);
- a reduction in seeds of palatable grasses, affecting seed-eating fauna such as the finches;
- degradation of riparian and wetland vegetation;
- increased soil erosion and reduced water quality due to loss of ground cover, trampling of stream channels and fouling of waterholes;
- increased spread of weeds.

AWC will aim to eradicate all large feral herbivores from within the fenced area, and reduce the densities of small feral herbivores (rabbits, hares) to ecologically insignificant levels. Outside fenced areas, AWC will aim to reduce densities of all feral herbivores to ecologically insignificant levels.

The ecological consequences of AWC's actions are likely to be the reverse of those listed above, i.e., an increase in cover of palatable plant species, more rapid recovery of vegetation after fire, reduced exposure of native animals to predators, improvements in

riparian and wetland condition, reduced soil erosion and a reduction in the spread of weeds. This will deliver substantial benefits to the biodiversity of the Pilliga.

6.1.2 Reintroduction of extinct mammals

In NSW, 25 mammals are listed as extinct under the NSW BC Act, while over 50% of surviving mammal species are listed as threatened. Extinctions and declines have fallen most heavily on small to medium-sized terrestrial mammals, in particular the following taxa (Woinarski et al., 2014):

- bettongs and potoroos (62% extinct or threatened)
- bandicoots and bilbies (50% extinct or threatened)
- small macropods (<5.5 kg) (45% extinct or threatened)
- rodents (39% extinct or threatened)
- dasyurids (20% extinct or threatened).

Most of AWC's proposed reintroductions to the Pilliga are from these guilds with further detail on each species provided in Section 4.4.

The direct benefit associated with the reintroductions will be a substantial increase in the global population of six nationally threatened mammals: see Table 1 (reproduced below as Table 14). The establishment of a new population for each of these nationally threatened species, and the increase in the overall population for each species, highlights the enormous environmental benefit of the proposal.

Table 14 (reproduced from Table 1): Global population of locally extinct mammals proposed for reintroduction into Pilliga and the estimated increase to population size as a result of the proposal.

Species	Global population estimate (2012)	Proposed Pilliga feral predator-free fenced area: potential population estimate*	% increase
Bridled Nailtail Wallaby	2,300	2,100	90%
Western Barred Bandicoot	3,000	1,550	50%
Bilby	10,000	850	8%
Brush-tailed Bettong	<18,000	2,900	16%
Plains Mouse	10,000	1,000 (600-5,800)	10%
Western Quoll	13,500	90 inside, 210 outside fence	1-2%

*Note: Population estimates are based on best available data, using information on home range and/ or density from areas of similar habitat and from other locations where feral predators are effectively controlled or absent. Populations are expected to vary considerably with rainfall.

Outline of reintroduction process

As noted in Section 4.6, reintroductions will commence by March 2019, with 5 regionally extinct mammal species reintroduced by April 2021. Reintroductions are dependent on eradication of feral predators from within the fenced area (see Section 4.3.4). The details of reintroductions will be provided in the Translocation Proposal to be developed for the proposal site. In brief, the herbivorous and omnivorous species will be reintroduced first, the carnivorous Western Quoll will be reintroduced last. Amongst herbivorous and omnivorous species, there is no particular order of reintroductions as no specific interactions amongst these species are expected. The timing of reintroductions will depend on the availability of source animals and other factors to be identified in the Translocation Proposal. Animals will be released directly into areas of suitable habitat within the large fenced area. For some species, temporary fencing may be used to establish a small holding pen to prevent a 'flight response' in released animals; again, details will be provided in the Translocation Proposal.

Consequences of reintroductions for ecological processes

Small-medium sized terrestrial mammals participate in a number of important ecological processes (Garkaklis et al., 1998, James and Eldridge, 2007, Eldridge and James, 2009, James et al., 2009, Fleming et al., 2014, Hayward et al., 2016) including:

- soil and litter turnover, with consequences for nutrient and water retention, litter volume and potentially fire risk (bettongs, bandicoots, bilbies);
- the dispersal of plants (e.g., Brush-tailed Bettongs are an important disperser of Sandalwood *Santalum* sp. (Murphy et al., 2005));
- the dispersal of fungi (bettongs are specialist fungivores, but bandicoots, bilbies, rodents and some macropods also eat fungi and disperse spores);
- herbivory (all except dasyurids);
- predation (dasyurids are specialist predators, but most other species are omnivorous).

Australian ecosystems are the product of millions of years of evolution involving small to medium-sized terrestrial mammals and the ecological processes in which they participate. For these reasons, the extinction and decline of small to medium-sized terrestrial mammals can be expected to have had major adverse consequences for long-standing ecological processes.

Conversely, the reintroduction of small to medium-sized terrestrial mammals can be expected to deliver a substantial ecological benefit by helping to restore historically-prevailing ecological processes. For example, the return of digging animals can be expected to result in rapid changes to rates of soil and litter turnover, and associated nutrient and water retention (Fleming et al., 2014, Garkaklis et al., 1998). The return of omnivores and predators is likely to help restore the structure of faunal assemblages. At AWC's Scotia sanctuary, the reintroduction of Bilbies and bettongs has resulted in a decline in scorpions (predatory invertebrates) and a subsequent increase in particular spiders (Silvey et al., 2015). Some of the changes in invertebrate assemblages associated with mammal reintroductions may have considerable knock-on impacts: e.g. termite activity at Scotia at the soil surface is much reduced in the presence of Bilbies, Burrowing Bettongs and Numbats, with possible consequences for rates of decomposition and turnover of organic matter (Coggan et al., 2016).

In summary, the changes to plant and animal assemblages and ecosystem processes that are associated with reintroductions can be assumed to be returning the system to the historical condition. That is, reintroductions can be seen as a fundamental step in the

restoration of a wide range of long-standing, important ecological processes in the Australian biota.

Consequences of reintroductions for extant fauna

As noted above, the mammal species proposed for reintroduction to the Pilliga participate in a number of ecological processes, including predation. The consequences for some invertebrates preyed on by these species (e.g. scorpions, termites) and knock-on effects for other invertebrates and ecological processes (more spiders, potentially slower decomposition) have been outlined above.

Consequences of reintroductions for extant vertebrates are less well understood. At AWC's Scotia sanctuary, there is evidence that some species of skink are less common inside the fenced area than outside. The mechanisms involved are presumably indirect, given that skinks are diurnal and mammals nocturnal. In contrast, there is good evidence that extant small mammals at Scotia are much more abundant inside the fenced area than outside. That is, any impacts of potential competition or predation by reintroduced mammals on extant small mammals is outweighed by the positive impacts on extant mammals resulting from the eradication of feral cats and foxes from inside the fenced area. Similarly, there is evidence from Scotia that ground-active birds (e.g. quail-thrush) are more abundant inside than outside the fenced area, again presumably because of the control of feral predators inside the fenced area. Based on mound activity, Malleefowl breeding success also appears to be much higher inside the fenced area than outside.

Consequences of reintroductions for vegetation

This REF addresses the issue of whether the reintroduction of regionally extinct mammals is likely to have any adverse impact on vegetation. Given the important ecological roles played by many small to medium-sized terrestrial mammals and the deep co-evolutionary history of the Australian biota, it is difficult to conclude that the restoration of native mammals is likely to have a negative impact on vegetation. However, it is necessary to consider whether, in the absence of pre-European predators (Dingoes and humans), population sizes of reintroduced mammals might reach 'artificially high' densities at reintroduction sites. At high densities, grazing by large native herbivores such as kangaroos can have significant impacts on vegetation (Letnic et al., 2012); however, impacts of smaller herbivores (bettongs, small macropods) are largely undocumented.

At Arid Recovery in South Australia, Burrowing Bettongs have been reintroduced and have reached relatively high densities within large fenced feral-predator free areas. A recent paper showed that some plant species are at low abundance in the presence of Burrowing Bettongs at Arid Recovery (Linley et al., 2017). However, that study focussed on vegetation in close proximity to the communal burrows of the Burrowing Bettongs, where grazing pressure could be expected to be especially high. Whether the effects were more general across the area have yet to be established. Also, whether these effects are likely to occur in locations other than Arid Recovery is unknown; it may be that this particular impact associated with the reintroduced Burrowing Bettong is evident at Arid Recovery because it is so arid. For example, there is no obvious evidence of 'over-browsing' by reintroduced mammals including Burrowing Bettongs, at AWC sanctuaries in more mesic locations. Finally, there is no evidence that the results at Arid Recovery in relation to Burrowing Bettongs apply to other species: Burrowing Bettongs are not proposed for reintroduction in the Pilliga.

In some cases, particular concern has been raised about impacts of reintroduced herbivores on threatened plants. For example, at Mulligan's Flat in the ACT, there has been some concern that the reintroduced Eastern Bettong may reduce numbers of a threatened ground

orchid. While bettongs do favour the orchid for food, current research suggests those impacts may be balanced by positive impacts of the Bettong on the orchid through soil engineering (diggings facilitate nutrient and water retention, and hence can increase recruitment: Ross 2016).

When considering the consequences of the proposal for vegetation, the positive impacts of the control of feral herbivores, including the eradication of goats and other large feral herbivores from inside the fenced area, must also be taken into account. These consequences are outlined in Section 6.1.1, above.

AWC is currently establishing a research project to quantify the outcomes of reintroductions and associated feral animal control on vegetation on all existing and proposed fenced areas on AWC-managed properties. Replicate permanent plots, stratified by vegetation type, have been established inside and outside fenced areas at AWC's Scotia, Newhaven and Mt Gibson sanctuaries, with plots to be established at remaining sanctuaries in 2017-18. In the Pilliga, AWC would apply the same methodology to monitor the consequences of reintroductions and associated control of feral herbivores for vegetation structure and composition. Permanent one hectare vegetation plots will be established inside and outside the fenced area proposed for reintroductions. Baseline surveys will be conducted in 2017.

The initial plot set-up and ground stratum measurements are based on a systematic two-stage sampling design. The base plot for ground structure is 100 x 20 m in size, in which 120 1 m x 1 m sub-plots are placed along five transects to record the frequencies of each ground and shrub layer species. Plant species will also be allocated to guilds which may also show changes in broader groups rather than individual species. Along each of the five transects, the substrate type, ground layer cover, shrub cover, and canopy cover will be recorded at 101 points using a point intercept method. Woody debris and hollow logs will be recorded by size class using a line intercept or transect method. Tree densities will be measured over a larger area than the base plot, which will be nested within a 1 ha plot to capture all size classes.

AWC would also establish plots in areas of known habitat for threatened plant species, and monitor outcomes of reintroductions for these species inside and outside the fence.

Consequences of reintroductions: summary

The reintroduction of regionally extinct mammals is expected to help restore the structure of plant and animal assemblages, and ecological processes, to a condition which is closer to the historical condition prevailing in the Pilliga proposal area. There are not expected to be any significant adverse impacts on extant fauna or flora as a consequence of reintroductions; rather, positive outcomes are expected. AWC will robustly monitor outcomes for plant and animal assemblages, and selected ecological processes. The proposal and associated monitoring and research will add significantly to existing knowledge of the Australian biota.

6.1.3 Management of any excess reintroduced mammals

As noted above, in the absence of pre-European predators (Dingoes and humans), population sizes of some reintroduced mammals may eventually attain relatively high densities within the fenced area. Reintroduced mammals are expected to alter the abundances of some extant plants and animals, such as preferred prey species, and these impacts are likely to be particularly evident when reintroduced mammals attain high densities. However, given the lack of baseline data, such as information on the historically prevailing abundances of any species, it is difficult to determine the 'carrying capacity' of the fenced area for reintroduced mammals ahead of the reintroduction. Further, if reintroduced

mammals are regulated primarily by resource availability, rather than by predation, considerable variation in the abundance of both reintroduced mammals and their preferred food plants or prey can be expected over time, ultimately driven by rainfall. These 'boom'/'bust' cycles are characteristic of biota in the Australian semi-arid zone.

For these reasons, it is not possible to identify 'triggers' for management intervention ahead of reintroductions. Instead, AWC will monitor key elements of the extant biota (vegetation, fauna) as well as population sizes of reintroduced mammals, to determine empirically the consequences of reintroductions. If monitoring reveals significant impacts of reintroduced mammals on extant biota that are considered to lie outside the bounds of acceptable change, then AWC may seek to reduce impacts of reintroduced mammals by:

- reducing the population size of reintroduced mammals through:
    - release of a proportion of individuals outside the fence (this action is part of the next stage of the EMA project, but would only occur in conjunction with intensive feral predator control outside the fence);
    - translocation of individuals to another reintroduction site (AWC has multiple reintroduction sites for the candidate species); or
    - by other means, such as introduction of terrestrial native predators such as the Western Quoll (which is planned for reintroduction at the Pilliga site);
- reducing impacts of reintroduced mammals on particular plants – e.g. threatened plants – by exclusion fencing within the reintroduction site. This approach has been adopted at Mulligan's Flat, primarily for research purposes.

6.1.4 Clearing of vegetation

Vegetation clearing as defined by OEH refers to the cutting down, felling, thinning, logging or removal of native vegetation (DEC, 2004). There are a number of potential impacts as a result of clearing any native vegetation, which include:

- destruction of habitat resulting in a loss of biodiversity;
- isolation of populations resulting in limited gene flow between small fragmented populations;
- reduced potential to adapt to environmental change;
- erosion leading to sedimentation that can affect both terrestrial and aquatic biota;
- disturbed habitat may encourage the establishment and spread of exotic flora or pioneer species that may displace local native flora
- loss of leaf litter which provides habitat for vertebrate and invertebrate fauna.

With regard to the proposal, vegetation clearing will occur as part of the construction of the proposed conservation fence and operations base and along the route of the proposed management trail within the fenced area. No other areas will be disturbed, and no rehabilitation of cleared areas is planned. Land required for temporary storage of fence materials and the like is already taken account of in the planning for the operations base area. Based on spatial analysis, approximately 62 ha of native vegetation would be removed or directly impacted as a result of the proposed fenced area and operations infrastructure, including the new management trail in the fenced area. Additionally, impacts are likely as a result of the creation of a strategic fire advantage zone (SFAZ) through the modification and/or removal of canopy connection and understorey removal. A summary of the vegetation communities to be impacted, their extents within the EMA project area, total to be modified by the proposed fenced area, operations base and new management trail are shown in Table 15. In total, only 0.17% of the EMA project area would be directly affected by the clearing of vegetation, with no more than 0.37% of any vegetation community affected by clearing.

Debris resulting from tree felling or clearing will be managed in one of the following ways, depending on its nature, volume and location:

- stacked into piles, inside and outside the fenced area: these will be allowed to degrade through natural process and are expected to provide habitat for native wildlife;
- windrowed or stacked into piles suitable for burning in accordance with approved burn plans to eliminate the build-up of fuel;
- possible harvesting timber for reuse in the construction of the operations base and future campground and education facilities – this would be subject to relevant regulatory approvals.

The specific quantities and locations of piles and windrows for burning and for habitat is difficult to predict and will be subject to the site factors encountered during clearing and the characteristics of the material involved. It is AWC's assessment, based upon experience in a similar environment, that alternating the piles inside and out minimises aesthetic impact and fire risk.

Table 15: Estimated extents of vegetation to be removed for the proposed conservation fence, operations base and associated infrastructure

Vegetation Community	Area in EMA project area (ha)	Area within proposed fenced area (ha)	Proportion of EMA project area PCT within proposed fenced area (%)	Area in proposed 15 m fence clearing (ha)	Proportion of EMA project area PCT in proposed 15 m fence clearing (%)	Area within proposed operations base (ha)	Proportion of EMA project area PCT within proposed operations base (%)	Area along proposed new trail (ha)	Proportion of EMA project area PCT along proposed new trail (%)
PCT 411/410	13,792	2,512.1	18	24.4	0.18	0.0	0	0.95	0.007
PCT 411/402	8,510	1,202.2	14	9.0	0.11	8.1	0.1	0.09	0.001
PCT 88	4,011	845.7	21	2.1	0.05	2.0	0.05	1.05	0.026
PCT 415	1,380	418.6	30	4.3	0.31	0.0	0	0.89	0.064
PCT 401	3,153	397.2	13	5.1	0.16	0.0	0	0.10	0.003
PCT 399	2,213	185.7	8	0.6	0.03	0.2	0.01	0.16	0.007
PCT 404	622	142.6	23	1.8	0.30	0.0	0	0.00	0
PCT 399/397	437	0.0	0	0.0	0	0.0	0	0.00	0
PCT 55	230	98.5	43	0.0	0	0.0	0	0.03	0.013
PCT 416	83	13.4	16	0.0	0	0.0	0	0.00	0
PCT 141/256	1,315	5.9	0.5	0.8	0.06	0.0	0	0.00	0
PCT 395	2	0.00	0	0.0	0	0.0	0	0.00	0
Total	35,748	5,821.7		48.1		10.3		3.3	

6.1.5 Removal of threatened flora

There are likely to be direct but insignificant impacts on two threatened flora species: *Commersonia procumbens* and *Tylophora linearis.*

Fifteen *T. linearis* plants were identified in the vicinity of the proposed fence and an additional 11 plants, in seven localities, within 5 m either side of the proposed management trail (which is proposed to be only 4 m in total width) were found (Figure 30 and Section 5.8.4). AWC considers there is likely to be at least many hundreds and probably more than a thousand plants throughout the EMA project area. Although efforts will be made to minimise any impacts, it would not be possible to realign the fence to avoid impacting any individual plant. Translocating plants would be unlikely to succeed. They would probably need at least several months in a nursery before transplanting, and the survival rate is likely to be low. They would then need to be watered and protected from herbivores for many months.

Commersonia procumbens plants were concentrated along the south-western part of the proposed fenceline and along the western portion of the proposed management trail route inside the fence (Figure 27 and Figure 28, Section 5.8.4). Many hundreds of plants were identified, all growing on areas disturbed by recent fire or earthworks. None were found in less disturbed habitat. Although efforts will be made to minimise any impacts, it would not be possible to realign the fence or management trail to avoid any individual plant.

No *Myriophylum implicatum* plants were found along the route of the proposed fence or management trail. All of the confirmed plants of this species found in the vicinity of the proposed fenceline were in one wetland which will be inside the fenced area. Both the fence and management trail routes avoid wetlands. It is possible that the plants in the wetland inside the fenced area could be exposed to indirect impacts but safeguards will be adopted to ensure that any changes to the wetland's water and sedimentation regimes caused by fence or management trail construction are insignificant. The safeguards will include minimizing removal of ground vegetation, not carrying out works during or soon after heavy rain, sediment control and runoff control measures, amongst others (Sections 6.2 and 7).

A further two species, Pine Donkey Orchid *Diuris tricolor* and Cobar Greenhood Orchid *Pterostylis cobarensis* may also occur within the clearing areas of the proposed CFAI but were not detected in the survey. It is likely that both species are widespread across a range of vegetation types, so that any plants impacted would only make up a very small percentage of the total population in the locality.

6.1.6 Barrier effects created by the conservation fence

Establishment of the fence involves clearing the fenceline and erecting an 1,800 mm netting fence with floppy top. The fence is a key component of AWC's plan to reintroduce 'extinct in NSW' mammals, as it permits permanent exclusion of feral predators, the primary threat to small to medium-sized mammals. As discussed in Section 6.1.2, the return of 'extinct in NSW' mammals is expected to help restore a range of ecological processes with positive consequences for ecological health.

The impact of the fence may include:

(i) barrier effects, and
(ii) mortality through collision or entanglement.

These impacts are discussed below, along with potential mitigation measures.

Barrier effects

The fence will be a permanent barrier to the movement of medium and large non-volant mammal species, large reptiles and Emus. The fence will not be a barrier to the movement of other bird species, small reptiles, frogs, fish or invertebrates. Plants dispersed by birds (with the exception of species dispersed by the Emu), wind and water will also be unaffected by the fence.

As a consequence, populations of some species inside the fence will be isolated from populations in the broader landscape. The primary guild affected will be extant medium-sized mammals. Reintroduced medium-sized mammals will not have populations outside the fence, at least in the initial stages of the EMA. Large kangaroos and Emus will be removed from inside the fenced area to prevent damage to the fence (adults will fight each other through the fence). While large reptiles will not be able to cross the fence, juveniles will be able to do so, and hence the fence will not act as a barrier to reptiles at the population level.

Isolation of populations of extant medium-sized mammals inside the fence can be expected to have a number of demographic and genetic consequences, if populations are small. These consequences are well-documented in the ecological literature and include increased vulnerability to local extinction as a result of stochastic events and loss of genetic diversity, given drift and inbreeding, for example, (Weeks et al., 2015). A related consequence is the effective removal of the population inside the fence from the broader regional population. If the regional population is small, this may increase the vulnerability of the population to local extinction through the mechanisms outlined above.

The species potentially affected include Echidna, Common Brushtail Possum, Black-striped Wallaby, Red-necked Wallaby and Swamp Wallaby. Of these, only the Black-striped Wallaby is a listed species. Another three threatened species – Koala, Spotted-tailed Quoll and Rufous Bettong – as well as the Common Ringtail Possum would also potentially be affected by the fence as a barrier, if they were present in the proposed fenced area. However, none of these species have yet been detected in the proposed fenced area in baseline surveys conducted by AWC.

Population sizes of all potentially-affected medium-sized mammals will be monitored by AWC both inside and outside the fenced area. While populations of medium-sized mammals are expected to increase in the fenced area following the eradication of feral cats and foxes, populations may still be sufficiently small to be subject to loss of genetic diversity over the long term. In these cases, occasional manual dispersal (i.e. capture and release) of individuals across the fence is likely to be sufficient to maintain connectivity between populations. The required rate of dispersal to maintain genetic diversity is likely to be low: a widely accepted number is one individual per generation, although the optimal rate will vary with population size, breeding systems and other factors. AWC will conduct targeted research to inform strategies for maintaining genetic diversity in threatened species such as the Koala that may be subject to a barrier effect from the fence.

Collision or entanglement of individuals with the fence

A second type of impact associated with fences is elevated mortality of species attempting to cross the fence from collision or entanglement.

In Australia, the main species involved in collisions or entanglements with fences are reported to be birds; especially night-flying and ground-nesting species, as well as the Echidna, medium-sized reptiles, snakes and turtles (Long and Robley, 2004, Hayward and Kerley, 2009, Hayward et al., 2014). While any mortality of native animals is unfortunate and will be avoided to the extent practicable, it is important to keep the scale of the issue in perspective. According to the review conducted by Long and Robley (2004):

> "Most fence managers indicated that native animals had been injured or killed in their exclusion fence. However, in all cases this occurred infrequently and is not considered to constitute a serious impact on resident fauna populations."

As the review conducted by Long and Robley (2004) is now over a decade old, AWC has conducted a review of its own fence mortality data and attempted to obtain more up-to-date information from other managers of fenced areas.

AWC fence mortality

At present, AWC has installed conservation fences enclosing feral predator-free areas on four wildlife sanctuaries, a total length of 109 km (Table 16). These fences are patrolled every 2-3 days. Collisions and entanglements in these fences were recorded in detail for periods ranging from 2-6 years at these sites.

Table 16: Conservation fences established on AWC wildlife sanctuaries, and years monitored for fauna collisions and entanglements

Location	Fence length (km)	Years monitored
Scotia	44	5
Mt Gibson	43	2
Yookamurra	13	6
Karakamia	9	4

During the period of monitoring, a total of 86 individuals of 28 bird species were reported killed on these fences, equivalent to a rate (across all species) of 1 bird/5 km fence/year. Of the bird species killed, 21 of the 28 were represented by 1 or 2 individuals. The remaining seven species were represented by 4 to 22 individuals (Table 17). The bird with the most recorded deaths on fences was the Budgerigar, but nearly all of these records (19 of 22) were from a single sanctuary (Scotia) in one year. The Chestnut Quail-thrush, the next most commonly killed bird, was also recorded killed on the fence at Scotia. This is a ground-active species. As a group, ground-active birds are more than twice as abundant inside than outside the fence at Scotia, presumably due to protection from feral predators. That is, the overall impact of conservation fencing is likely to be positive for ground-active species such as Chestnut Quail-thrush, despite occasional fence mortalities.

Table 17: Bird species represented by more than 2 individuals killed on conservation fences established on AWC wildlife sanctuaries during years monitored for fauna collisions and entanglements

Species	No. individuals
Stubble Quail	5
Australian Ringneck	6
Budgerigar	22
White-fronted Honeyeater	6
Chestnut Quail-thrush	11

Species	No. individuals
Crested Bellbird	4
Rufous Whistler	4

Other species recorded killed on fences in the period monitored were a King Brown Snake, a Bearded Dragon and five Sand Goannas. Surveys have shown that goannas are more abundant inside the fence at Scotia than outside, so the overall impact of fencing on reptiles is also likely to be positive, despite the mortalities.

AWC will patrol the proposed Pilliga fence every 2-3 days. Any collisions or entanglements will be recorded.

Mortality on other conservation fences

Summary data on fence mortality were provided by managers of Arid Recovery (SA) and Mulligan's Flat (ACT).

Arid Recovery has 34 km of conservation fencing enclosing 6,000 ha. According to the manager:

> "Birds make up the majority of fence deaths (65%). The majority of deaths were pigeons and doves (27%) and waterbirds (27%). Quail and quail-thrushes made up 14% with the rest honeyeaters, finches, parrots and an owl.
>
> 25% of recorded fence deaths were reptiles, comprised of a mix of large dragons, goannas and snakes that had become stuck in the netting or caught on hotwires.
>
> Mammals are less common and mostly found dead from unknown causes (no sign of collision injury) or as a result of raptor predation, with only one recorded as directly killed by the fence." (Dr K Tuft, pers. comm. 2016, with AWC).

Mulligan's Flat has 11.5 km of conservation fencing enclosing 400 ha. According to the manager, animals killed on the fence include birds, medium-sized reptiles and turtles. As at Scotia, many of the affected species are expected to be more abundant inside the fence than outside due to removal of feral predators and other threats (Dr J Cummings, pers. comm. 2016, with AWC). A recent study found that Long-necked Turtles were vulnerable to entrapment by the fence at Mulligan's Flat when attempting to disperse between wetlands (Ferronato et al., 2014). Conversely, a study of Bush Stone-curlews, a ground-active, nocturnal bird reintroduced to Mulligan's Flat, found individuals of that species readily flew without incident back and forth across the fence (Dr J Cummings, pers. comm. 2016, with AWC).

Species affected

Based on the information presented above, the species most likely to experience some level of mortality on fences at Pilliga are as follows:

- quail, button-quail and quail-thrush (6 species),
- pigeons and doves (5 species),
- parrots (16 species),
- medium-sized skinks and goannas (6 species), and
- turtles: two species.

Summary

As noted above, overall levels of mortality from the fence are expected to be low, in the order of 1 bird/5 km fence/year over the long term, or six individual birds in the Pilliga per year. Many of the small ground-active bird species are predated by feral cats and foxes, and hence are likely to benefit overall from the fence, despite occasional fence strike. Reptile deaths are likely to be considerably lower than birds, with the possible exception of turtles. Given the limited availability of wetlands suitable for turtles inside the fenced area at Pilliga, the risks are likely to be low.

AWC's fence design mitigates against one of the potential causes of mortality, namely electrocution of ground-active species such as the Echidna, as there are no hot wiresclose to the ground.

AWC will patrol the proposed Pilliga fence every 2-3 days. Any collisions or entanglements will be recorded.

6.1.7 Impacts of changes in fire management on ecological values

The impacts of the proposed hazard reduction burns and mechanical disturbances on the existing environment and ecological values within the proposal area will vary with the zone type and the area of each burn or mechanical treatment. Across all proposed burns there will be a substantial reduction in surface fuel load and continuity. This is likely to reduce available foraging and shelter habitat for shrub-inhabiting species of fauna within the relatively narrow SFAZs. However, by reducing fuel loads in these targeted and strategic areas we aim to disrupt the potentially catastrophic outcomes of a large-scale, high-intensity wildfire on habitat structure and availability, as well as to protect the nationally-significant populations of regionally-extinct fauna within the fence.

6.1.8 Aboriginal cultural heritage

The Pilliga forest and Pilliga SCA have a long history of usage by Aboriginal people, and more recent usage by Europeans. Both Aboriginal heritage and European heritage are important records of Australian history.

The planned works have the potential to impact Aboriginal cultural sites. Notably this impact may be through the construction of the fenceline and new management trail (through clearing activities) and the operations base (clearing and building). The risk of impact to cultural heritage sites outside of these sites is low as works will largely be limited to roads and management trails or otherwise be conducted on foot (see Section 5.12.1 for stop work procedure should sites be discovered).

To mitigate the risk of disturbance, AWC engaged an appropriately qualified and experienced consultant – Onsite Cultural Heritage Management – to prepare an Aboriginal Cultural Heritage Assessment report in relation to the proposal. The report for the fenceline and operations base has been prepared, and locations of items identified within the vicinity of the proposal are shown in Figure 49. The report is appended to this REF (Appendix 11).

An additional survey was carried out by Craig Trindall Consulting Pty Ltd along the route of the proposed new management trail (see Appendix 11 for the report). One heritage item – a culturally modified tree – was identified and the new trail will be diverted to avoid it, with a buffer of at least 10 m.

6.2 Indirect Impacts

Indirect impacts as defined by the OEH occur "when project-related activities affect species, populations or ecological communities in a manner other than direct loss". Indirect impacts include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertilizer drift or increased human activity within or directly adjacent to sensitive habitat areas" (DECC, 2007).

Based on this definition, it is anticipated that the clearing of vegetation associated with the proposal would have the potential to result in a number of indirect impacts relating to edge effects, soil erosion, a possible increase in traffic, and weed invasion. The previous history of land use in the region (mainly forestry) has already introduced these hazards to the area. These potential for the proposal to add to the existing indirect impacts are considered under separate headings below.

6.2.1 Edge effects

The removal of vegetation can often result in edge effects; the creation of new environmental conditions that have the potential to have negative impacts on ecological processes along the edges of cleared environments, particularly those that originally contained canopy vegetation. Edge effects generally promote the invasion of exotic flora (weeds) and may also promote increased visitation by red foxes and feral cats (Lindenmayer and Fischer, 2006, Edwards et al., 2001, Priddel et al., 2007, Miles, 2006b, Miles, 2006a).

In general, potential edge effects associated with the proposal may include:

- changes in microclimate (e.g. temperature, wind, light)
- creation of new ecotones
- invasion by exotic flora
- improved access for feral predators
- isolation of populations resulting in limited gene flow between small, fragmented populations
- reduced potential to adapt to environmental change.

A holistic approach to assessing edge effects is not possible given that edge effects can vary between species and communities. However, this potential impact is considered unlikely to be significant given:

- edge effects are most severe where extensive clearing separates – or fragments- areas of remnant native vegetation by long distances; the proposal does not fragment the native vegetation in this way;
- the proposal intends to remove access for feral predators;
- the planned ongoing management of weeds.

6.2.2 Traffic

During construction, levels of traffic to Railway Survey Road, Bens Road and other minor roads in the locality may increase during the construction phase as vehicles begin to transport machinery for vegetation clearing and fence materials. Once operational, the proposal has the potential to result in some increased traffic along Railway Survey Road, Bens Road and other minor roads from AWC support vehicles and potential additional

visitation to the region. The impacts are not likely to be significant. Roads and management trails will be maintained in accordance with roads management requirements.

6.2.3 Soil erosion

Clearing of vegetation along the line of the fence and the new management trail and for the operations base will expose soil and increase the risk of erosion. The removal of mid-storey vegetation in fire protection zones would require removal of shrubs and seedlings by the roots to minimise regrowth and this would also expose soil to erosion.

Potential impacts resulting from soil erosion may include, but are not restricted to:

- sedimentation in drainage lines
- alterations to habitat
- loss of topsoil and native seedbank
- opportunities for weeds to establish in the absence of native plants.

The potential soil erosion impacts are likely to be limited given the flatness of the landscape and proposed safeguards. All works will follow the guidelines of NPWS field policies and the Department of Conservation and Land Management 'Urban Erosion and Sediment Control Manual'. The proposed safeguards take into account the added risk associated with any moderate to heavy precipitation events following vegetation clearing.

Design features (such as the retention of groundcover vegetation where possible and the retention of vegetation outside the impact area) and a series of mitigation measures are likely to avoid or limit the potential impacts of any soil erosion.

A series of proposed safeguards/measures that will minimise the likelihood of indirect impacts affecting any biota within the study area are provided throughout Section 6.3 of this REF and in summary in Section 7 of this REF.

6.2.4 Weeds

Tiger Pear and Prickly Pear plants were detected in numerous locations along the proposed fenceline. They are also found throughout the study area (OEH). Given this presence on the fenceline, there is some potential for both species (and other weed species) to be spread, or become established post-clearing of native vegetation. Safeguard measures that will minimise the likelihood of weed establishment and invasion are proposed and are described below.

- All vehicles, machinery and equipment entering the site (prior to arrival) are to be thoroughly cleaned inside and out to reduce potential for weed seed spread.
- Prior to commencing work on the site, all vehicles and equipment will be delivered to and inspected as cleaned in a common inspection area. Any additional cleaning prior to commencement of works will be undertaken in the common inspection area.
- Vehicles and equipment working within the construction zone will be inspected daily with any identified weed seeds or segments removed and disposed of appropriately.
- The area of disturbance and immediate surrounds will be continually monitored during and after construction activities to identify and control any weed populations that have established as a result of works. Particular focus will be on eradication of any establishment of noxious weeds in the area of disturbance.
- All weed incursions will be monitored and controlled by a person experienced in weed management.

The EMA project (including the proposal) involves an increase in the level of weed control within the area to be fenced and across the balance of the Pilliga EMA project area: a comprehensive weed strategy will be developed by the end of 2017, once AWC has collected more information on species' distribution and the threats they represent. As a result, the proposed action will deliver a significant benefit to the environment by reducing the overall level of weeds in the proposal area.

6.2.5 Riparian impacts

Potential impacts to riparian areas and ephemeral creeks are likely to be limited to the clearing of native vegetation for the proposed fenceline and new management trail. Mapped creeks (all ephemeral) that would be crossed by the proposed fence are shown in Figure 51. The proposed fenceline itself has been planned and designed to minimise obstruction to any ephemeral creek and allow small aquatic fauna to easily pass unobstructed. The minor drainage lines upstream of the proposed fence rarely flow and are not known to have large fish. Therefore, the fence is unlikely to be a barrier to fish movements.

The proposed fence design as it passes over ephemeral creeks is provided in Appendix 4 and consists largely of a modified version of the main fence including use of netting and 'reo-mesh' through the water course, reinforced with steel cables and heavy duty posts (typically rail iron). This design has been used and proven on AWC's Mt Gibson Wildlife Sanctuary fence project and allows the continued natural flow of water along the watercourse and limits erosion through minimising disturbance to the natural landform. To allow vehicular access and assist with minimising erosion potential, material such as 'blue metal' (i.e. suitable rock chips) is used to line the banks and base of the watercourse. It is planned that two creek crossings will require the modified fence design: Rocky Creek, off Bens Road, and Rocky Creek near Railway Survey Road. The remainder of the crossings will utilise a standard fence design. As the fence is installed, an onsite assessment of each remaining crossing will determine if erosion measures such as blue metal are required. Further, over the course of the project life, assessments will be made of the fence to determine if the modified design is required at other water crossing locations. It is assessed that the impact of the creek crossings is not likely to be significant.

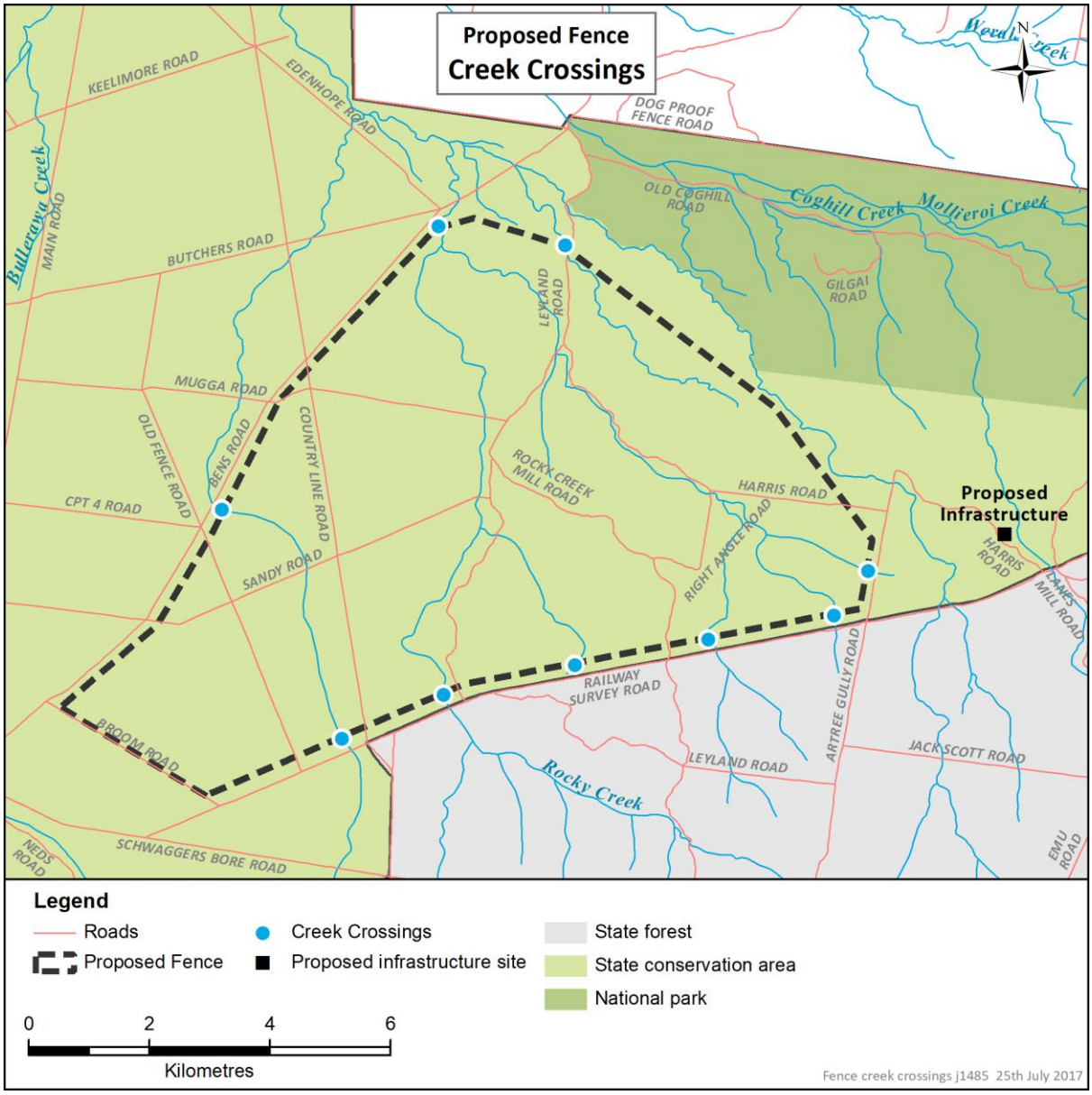


Figure 51: Locations where the proposed fence will cross beds of ephemeral creeks

The operations base is located on Harris Road, adjacent to Coghill Creek and at least 130 m from the bank of the creek. Safeguards will be in place to avoid any significant impacts from potential erosion and sedimentation as a result of clearing/modifying vegetation for the APZ around the operations base. This includes the use of 'Whoa-boys' on new management trails to slow the movement of rainwater, and divert the water back onto natural vegetation and groundcover (not directly to the creek) to allow the water to subside naturally. Road base will be applied to the new management trail within the operations base to minimise movement of debris and sediment.

The operations base buildings with waste and water services will utilise onsite sewerage management. Specifically, this includes using septic tanks and leach drains that will be sited adjacent to the building, and no closer than 130 m to the edge of creeks or watercourses (in accordance with regulations). Septic systems will be inspected regularly (no less than annually) for correct operation, and will be sited in such a manner that water flowing from trails or buildings will not cause the septic systems to overflow. Larger buildings with multiple

waste water outlets (e.g. visiting staff accommodation) will utilise systems with multiple leach drains that allows one drain to rest, thereby mitigating any risk of overflows.

6.2.6 Cumulative impacts

The Pilliga forests are within the traditional lands of the Gamilaroi People and, like most of the woodlands of southern Australia, were presumably managed with fire for millennia (Gammage 2011). European settlers arrived in the 1830s and, despite various attempts, the sandy soils of the Pilliga proved unfavourable to pastoralism (Rolls 1981). Subsequently, forestry became the major land-use (Dargavel and Kowald 2001). Most of the Pilliga forests have been selectively logged for over a century, with a particular focus on forests on the Pilliga outwash. The impacts of forestry in the EMA project area are evident in the density of the road network, the numerous unmarked snig tracks, the stumps left by logging and thinning, the ringbarked eucalypts, and in the structure of the forest itself (Whipp et al. 2012). Additional major historical impacts relate to the invasion of the forests by rabbits, which suppressed regeneration of cypress pine until the introduction of myxomatosis in the 1950s; the introduction of prickly pear, which spread widely through cypress forests in the late 19th century and dominated the understorey for decades; and the suppression of fire throughout forest management (Harris and Lamb 2001).

A number of actions as a result of the proposal have the potential to add to these impacts; these are identified and discussed throughout this document. Some negative cumulative impacts are likely to occur as a result of the proposal due to the clearing of 62 ha of vegetation, mostly in linear strips, and soil disturbance associated with fence construction. These impacts are considered minor in the context of the century or more of disturbance experienced in the project area, documented above. The proposed Narrabri Gas Project will introduce additional clearing and other disturbances to the Pilliga region, however these impacts will occur to the east of the EMA project area and are not expected to have any material cumulative impacts in relation to this proposal.

6.3 PHYSICAL AND CHEMICAL IMPACTS DURING CONSTRUCTION AND OPERATION

Physical and chemical impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
1. Is the proposal likely to impact on soil quality or land stability?	☒	Low to medium, Negative	Impacts to soil quality and land stability are anticipated to be low to moderate during the proposed activity. The highest potential will be during vegetation removal. Temporary negative impacts on soils or land stability would be confined to the fence clearing, track clearing and	Where possible, ground vegetation will be retained to minimise soil disturbance. All works will follow the guidelines of NPWS field policies and the Department of Conservation and Land Management 'Urban Erosion and Sediment Control Manual'. This will include:

Physical and chemical impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
			APZ creation where direct excavation and vegetation removal is required. As detailed in Table 15, about 62 ha of native vegetation would be removed. This represents a small portion of the total EMA project site (0.17%). All of the work would be undertaken using machinery and with appropriate safeguards, these impacts will be minimised.	1. Works should not take place during, or within 4 days of heavy rain events (other than work necessary to ensure that soil erosion is minimised). Works should not be scheduled when heavy rainfall is forecast. 2. Sediment controls will be left in situ until the excavated surfaces are stable. 3. Where possible, all foot traffic and light vehicle movements will be confined to existing management trails or the clearing constructed for the fenceline. 4. The site supervisor, through site inductions, will make all personnel aware of risks and responsibilities related to spills of fuel, oil and other chemicals that may be required onsite. Machinery and vehicles will be inspected on a daily basis giving particular attention to the condition of hoses and connections. 5. An emergency spill kit must be kept onsite at all times. Staff and contractors using machinery must be made aware of the location of the spill kit and trained in its use. 6. Hay bales will only be used as an erosion control method if they are certified weed free. 7. Longer term the control of feral herbivores and restoration of ecological processes should reduce soil erosion across the proposal area.
2. Is the activity likely to affect a waterbody, watercourse, wetland or natural drainage system?	☒	Low to medium, Negative	Sediment created as a result of vegetation removal has the potential to reach drainage lines. There are numerous drainage lines and several swamps across or near the sites to be cleared, most of which drain into Coghill Creek. Therefore, turbid runoff has the potential to reach drainage lines and send suspended sediments off-site. Similarly,	There must be no release of dirty water into drainage lines or wetlands. Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) must be carried out on a regular basis to identify any potential spills or deficient erosion and sediment controls. Fuels and chemicals must be stored in an impervious bunded area a minimum of 50 m away from:

Physical and chemical impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
			runoff contaminated by petrochemicals is also possible given the proposed use of machinery which use a series of oils and fuel. With appropriate safeguards, the risks from these potential impacts will be minimised.	• rivers, creeks or any areas of concentrated water flow; • flooded or poorly drained areas; • slopes above 10% gradient.
3. Is the activity likely to change flood or tidal regimes, or be affected by flooding?	☐	NA	NA	NA
4. Is the activity likely to affect coastal processes and coastal hazards, including those projected by climate change (e.g. sea level rise)?	☐	NA	NA	NA
5. Does the activity involve the use, storage, or transport of hazardous substances or the use or generation of chemicals, which may build up residues in the environment?	☒	Negligible, Negative	There is a potential risk of petrochemical spills from the use of machinery that contains oil and fuel.	No additional safeguard other than already proposed are necessary.
6. Does the activity involve the generation or disposal of gaseous, liquid or solid wastes or emissions?	☒	Negligible, Negative	Minor negative impacts to air quality may result by the generation of exhaust fumes from machinery during the clearing of vegetation phase. Fine particulate matter such as dust as a result of the	1. All machinery (including vehicles) will be periodically inspected and maintained to ensure minimum levels of emissions. 2. Engines will be switched off, rather than left idling for long periods.

Physical and chemical impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
			vegetation removal could also occur. Emissions would be generated during the operation of the machinery and motor vehicles. Small amounts of rubbish are also likely to be generated by personnel. These impacts would be restricted to the period of the proposal and during scheduled maintenance. With appropriate safeguards, these potential impacts will be minimised.	3. Rubbish generated during works will be minimised and where generated, would be disposed of in an appropriate manner.
7. Will the activity involve the emission of dust, odours, noise, vibration or radiation in the proximity of residential or urban areas or other sensitive locations?	☒	Negligible, Negative	During construction, some dust is likely to be generated by both the clearing operations and general use of motor vehicles and machinery. During operation, an increase in AWC vehicles could result in the potential for additional dust on public roads throughout the Pilliga. However, no residential, urban areas or other sensitive locations are adjacent to the proposal.	To reduce the potential level of dust, AWC support vehicles will be limited to a maximum speed of 60 km/h on public roads, and 40 km/h on park roads.

6.3.1 Proposed safeguards

It is proposed to adopt the following safeguards in relation to physical and chemical impacts during construction and operation of the proposal:

- Where possible, ground vegetation will be retained to minimise soil disturbance.
- All works will follow the guidelines of NPWS field policies and the Department of Conservation and Land Management 'Urban Erosion and Sediment Control Manual'.
- Works should not take place during, or within 4 days of heavy rain events (other than work necessary to ensure that soil erosion is minimised). Works should not be scheduled when heavy rainfall is forecast.
- Sediment controls will be left in situ until the excavated surfaces are stable.

- Where possible, all movements (including foot traffic) will be confined to existing management trails or the clearing constructed for the fenceline.
- The site supervisor, through site inductions, will make all personnel aware of risks and responsibilities related to spills of fuel, oil and other chemicals. Machinery will be inspected on a daily basis giving particular attention to the condition of hoses and connections.
- An emergency spill kit will be kept onsite at all times. Staff and contractors using machinery will be made aware of the location of spill kits and trained in its use.
- Hay bales will only be used as an erosion control method if they are certified weed free.
- There must will be no release of dirty water into drainage lines and/or waterways.
- Visual monitoring of local water quality (i.e., turbidity, hydrocarbon spills/slicks) will be carried out on a regular basis to identify any potential spills or deficient erosion and sediment controls.
- Fuels and chemicals will be stored in an impervious bunded area a minimum of 50 m away from:
    - rivers, creeks or any areas of concentrated water flow
    - flooded or poorly drained areas
    - slopes above 10%
- All machinery will be periodically inspected and maintained to ensure minimum levels of emissions.
- Engines will be switched off, rather than left idling for long periods.
- Rubbish generated during works will be minimised and where generated, will be disposed of in an appropriate manner.
- To reduce the potential level of dust, AWC support vehicles will be limited to a maximum speed of 60 km/hour on public roads, and 40 km/hour on park roads.

6.4 BIOLOGICAL IMPACTS DURING CONSTRUCTION AND OPERATION

Biological Impacts During Construction and Operation			
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)
1. Is any vegetation to be cleared or modified? (includes vegetation of conservation significance or cultural landscape value)	☒	Medium, Negative	The proposal would result in direct impacts to 62 ha of native vegetation. This includes the removal of vegetation along a strip up to 15 m wide for the proposed fence. In total, only 0.17% of the study area would be directly affected by the clearing of vegetation, with no more than 0.37% of any vegetation community affected by clearing. Additional minor impacts to vegetation are likely should the SFAZ be implemented.

Biological Impacts During Construction and Operation			
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)
			Some indirect minor impacts on vegetation are also likely including edge effects, traffic and soil erosion. Proposed safeguards (set out in Section 6.4.1 below) are likely to prevent the establishment of weeds and spread of weeds. Significant positive impacts on vegetation will arise as a result of the removal of feral herbivores, especially rabbits, goats and pigs, and the restoration of ecological processes as a result of reintroduced small mammals.
2. Is the activity likely to have a significant effect on threatened flora species, populations, or their habitats, or critical habitat (refer to threatened species assessment of significance (5-part test))?	☒	Medium, Positive	The works are not likely to have a significant adverse effect on threatened flora species, populations or their habitats. The proposal would have a positive impact on threatened flora by removing feral herbivores from a significant area (5,800 ha) and reducing the density of feral herbivores across the larger EMA project area (an additional ~30,000 ha). The proposal would also have a positive impact by reducing noxious weeds across a large area. The proposal would establish significant new populations of at least 6 nationally threatened mammals. The reintroduction of threatened mammals would restore ecological processes which, in turn, would potentially benefit threatened flora. The proposal would have a direct but insignificant negative impact on a small number of threatened flora species (see Section 6.1.5) as a result of the clearing for the fenceline. There will be a significant positive impact on these species as a result of feral herbivore removal and weed control. Additional assessments under the BC Act, FM Act and EPBC Act are provided in Appendices 7 and 8.
3. Does the activity have the potential to endanger, displace or disturb fauna (including fauna of conservation significance) or create a barrier to their movement?	☒	Medium, Positive	The proposal would have a positive impact on fauna as a result of the removal of feral predators and the effective removal of feral herbivores over a large area (5,800 ha) and increased control of feral animals over a broader area (30,000 ha). In addition, 6 regionally extinct fauna species would be reintroduced. In turn, this would restore important ecological processes. The potential adverse impacts to fauna, including disturbance and displacement, resulting from the proposal would not be significant. They include: 1. Direct impacts as a result of clearing the fenceline, with the potential to affect less mobile fauna occupying soil and vegetation such as

Biological Impacts During Construction and Operation			
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)
			reptiles, invertebrates, frogs and small terrestrial mammals. 2. Habitat loss by the removal of a relatively small area of vegetation (62 ha) and hollow-bearing trees (see Section 5.8.4). The loss of hollow bearing trees is not significant in the context of the proposal area. 3. Short-term disturbance during the works to any noise-sensitive species. The fence would also create a barrier to movement for a small number of fauna species that cannot pass through the netting on the fence, or fly or glide over it. A range of safeguards will be put in place – see Section 6.4.1 below. The potential negative impacts on fauna would not be significant, particularly when the proposed safeguards are taken into account. The positive impacts are significant. Additional assessments for species listed under the BC Act, FM Act and EPBC Act that have the potential to be impacted by the proposal are provided in Appendices 7 and 8.
4. Is the activity likely to have a significant effect on threatened fauna species, populations, or their habitats, or critical habitat (refer to threatened species assessment of significance (5-part test))?	☒	Medium, Positive	The works are not likely to have a significant adverse effect on threatened fauna species, populations or their habitats. The proposal would result in the removal of some potential habitat and forage for some threatened and migratory biota. However, the nature and extent of the removal of habitat/forage is not significant: see Appendices 7 and 8. See also the safeguards set out in Section 6.4.1 below. The proposal would have a positive impact on threatened and migratory fauna by removing feral predators and herbivores from a significant area (5,800 ha) and reducing the density of feral predators and herbivores across the larger EMA project area (an additional ~30,000 ha). The proposal would also have a positive impact by reducing noxious weeds across a large area (e.g. Tiger Pear is a threat to Koalas). The proposal would establish significant new populations of at least 6 nationally threatened mammals. The reintroduction of threatened mammals would restore ecological processes which, in turn, would potentially benefit several extant threatened species.

Biological Impacts During Construction and Operation			
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)
			The proposed fence would act as a barrier to a small number of species unable to pass through the fence, or fly or glide over it. The impact is not likely to be significant. Additional assessments under the BC Act, FM Act and EPBC Act are provided in Appendices 7 and 8.
5. Is the activity likely to impact on an ecological community of conservation significance?	☒	N/A	No direct or indirect impact to an ecological community of conservation significance is anticipated.
6. Is the activity likely to have a significant effect on an endangered ecological community or its habitat (refer to threatened species assessment of significance (5-part test))?	☒	Low, Negative	The proposal would not directly impact on any TEC. However, indirectly and in the absence of appropriate mitigation measures and safeguards, there is a very low risk of impact to the Gilgai wetland TEC as a result of sediment. The proposed safeguards (see Section 6.4.1) will ensure no significant impact occurs. Additional assessments for communities under the BC Act, FM Act and EPBC Act that have the potential to be impacted by the proposal are provided in Appendices 7 and 8.
7. Is the activity likely to cause a threat to the biological diversity or ecological integrity of an ecological community?	☒	Moderate, Positive	The proposed works would significantly enhance the ecological integrity/biological diversity of the proposal area by: • Removing/reducing the key threat to ecosystem integrity/biological diversity – feral predators and herbivores – as well as other threats such as weeds. • Reintroducing at least 6 threatened mammals that are currently regionally extinct. In addition to enhancing biological diversity in itself, the return of these 6 species would restore a range of ecosystem processes which will enhance ecosystem integrity. The proposal would involve the clearance of 62 ha of native vegetation. However, this will not cause a threat to biological diversity or ecological integrity, especially when the safeguards (Section 6.4.1) and the relatively small scale of this impact in the context of the project area (35,000 ha) and wider locality are considered.

Biological Impacts During Construction and Operation			
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)
8. Is the activity likely to introduce noxious weeds, vermin, feral species or genetically modified organisms into an area?	☒	Low, Positive	The works are not likely to introduce noxious weeds or feral animals. Weeds are already established in the study area, including Prickly Pear and Tiger Pear. The proposal will significantly reduce the extent of weeds through weed control across the proposal area. There is a risk that construction of the fence, or the use of vehicles in ongoing operations, could result in the introduction and/or spread of weed species. However, this risk is reduced to negligible levels by the safeguards set out below in Section 6.4.1 and the fact that landscape-scale weed control will be implemented across the surrounding EMA project area.
9. Is the activity likely to affect areas of outstanding biodiversity value?	☐	N/A	No areas of outstanding biodiversity value as listed by the BC Act are present within the study area.
10. Is the activity consistent with any applicable recovery plans or threat abatement plans?	☒	High, Positive	Generally, the works are consistent with management plans, recovery plans or actions devised under the Saving Our Species Program in that feral animals such as red fox, feral cat, pig, goat and rabbit would be eradicated from the proposed fenced area. The works are also consistent with the National Threatened Species Strategy and Recovery Plans prepared under the EPBC Act (see Appendices 7 and 8), as well as the Feral Cat Threat Abatement Plan.
11. Is the activity likely to affect any joint management agreement entered into under the BC Act?	☐	N/A	No Joint Management Agreement under the BC Act is present for the Pilliga SCA.

6.4.1 Proposed safeguards

Construction phase

It is proposed to adopt the following safeguards in relation to biological impacts during construction and operation of the proposal:

- A pre-clearance fauna survey will be completed by suitably qualified persons. This will generally involve inspections of logs, rocks and leaf litter and fallen timber for

frogs, reptiles and mammals. Any fauna found will be relocated to adjacent habitat. This survey will occur on the same day as clearing takes place.
- Any vehicles required for the construction of the proposal will remain on existing management trails and within the footprint of the CFAI clearings. Foot traffic will be minimised outside of the clearing footprint.
- Where possible, ground vegetation will be retained to minimise soil disturbance.
- All vehicles, machinery and equipment entering the site (prior to arrival) will be thoroughly cleaned inside and out to reduce potential for weed seed spread.
- Prior to commencing work on the site, all vehicles and equipment will be delivered to and inspected as cleaned in a common inspection area. Any additional cleaning prior to commencement of works will be undertaken in the common inspection area.
- Vehicles and equipment working within the construction zone will be inspected daily with any identified weed seeds or segments removed and disposed of appropriately.
- The area of disturbance and immediate surrounds will be continually monitored during and after construction activities to identify and control any weed populations that have established as a result of works. Particular focus will be on eradication of any establishment of noxious weeds in the area of disturbance.
- All weed incursions will be monitored and controlled by a person experienced in weed management.
- Removal of hollow-bearing trees will be carried out in accordance with guidelines detailed in Appendix 12.
- To avoid the spread of noxious weeds within the construction zone to the surrounding area, the tyres of all construction vehicles will be checked daily to remove any attached segments of weeds and post-construction surveys will be undertaken to locate and spray any accidentally translocated plant segments that may have established.

Fence and reintroduction safeguards

Given the diverse ecological roles played by reintroduced mammals, the complexity of ecosystems and the long-term nature of some ecological processes (e.g. tree recruitment), it will take time and directed research effort to identify and quantify benefits and impacts, including any 'adverse' impacts that may require mitigation. The efforts that will be taken to identify any quantify any impacts, and safeguards that will be triggered, are described below.

- Post-approval monitoring (AWC draft Ecological Health Monitoring Framework, Appendix 13) as described in Section 4.3.9 will be implemented by AWC.
- AWC will acquire comprehensive baseline data on vegetation and vertebrate fauna at reintroduction sites, and measure any impacts/changes as result of mammal reintroductions using a BACI design (as set out in the draft EHMF).
- In addition, AWC will monitor population sizes of reintroduced mammals.
- Over time, the information gained from this research/ monitoring will provide robust data on the ecosystem consequences of reintroductions.
- Should this monitoring suggest that population size of some species is small and subject to potential loss of genetic diversity due to the conservation fence, AWC will conduct occasional manual dispersal (capture and release) across the fence (both ways) to maintain connectivity between populations. The required rate of dispersal to maintain genetic diversity is likely to be low: a widely accepted number is one individual per generation.
- Should monitoring of the conservation fence confirm that bird strike is an issue, AWC will investigate the possible retrofit of mitigation measures. For example, the

incidence of bird strike (grouse and capercaillie) on deer fences in Scotland has been reduced by incorporating wood or plastic into the fences to make them more visible to the birds (Trout and Kortland, 2012).

- If particular components of the vegetation are declining following reintroductions, and the scope/ rate/ focus of that decline is of conservation concern, then AWC will identify and implement an appropriate mitigation strategy. This might include:
    - reducing the population size of reintroduced mammals through: (i) release of a proportion of individuals outside the fence (this action is part of the next stage of the EMA project); (ii) translocation of individuals to another reintroduction site (AWC has multiple reintroduction sites for the candidate species); or (iii) by other means, such as introduction of terrestrial native predators such as the Western Quoll (which is planned for reintroduction at the Pilliga site);
    - reducing impacts of reintroduced mammals on particular plants – e.g., threatened plants, by exclusion fencing within the reintroduction site (this approach has been adopted at Mulligan's Flat, primarily for research purposes).

6.5 COMMUNITY IMPACTS DURING CONSTRUCTION AND OPERATION

Community impacts during construction and operation				
	Applicable?*	**Likely impact** (negligible, low, medium or high negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of the impact, the nature of the receiving environment and any proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
1. Is the activity likely to affect community services or infrastructure?	☒	Negligible, negative	The proposal would likely result in modest additional vehicle traffic on roads in the Pilliga, mostly during the construction phases of the proposal.	Vehicle speed will be limited to 60 km/h on public roads, and 40 km/h within the park, to minimise the potential impact of dust and noise.
2. Does the activity affect sites of importance to local or broader community for their recreational or other values or access to these sites?	☒	Low, Negative	The fenced area, once complete, would no longer be freely accessible to the general public: access would be regulated. However, a process of broader environmental education and visitor experiences will commence after mammal reintroductions. The proposal is limited to a small portion of the Pilliga SCA (about 15%) with the remainder of Pilliga SCA and other land within the Pilliga still available for community use. Access to cultural heritage or historic heritage sites within the	No safeguards are considered necessary. Access will be arranged with relevant groups, including native title bodies and traditional owners. Access for the community will be provided as part of a managed visitation program following completion of the reintroduction program.

Community impacts during construction and operation				
	Applicable?*	**Likely impact** (negligible, low, medium or high negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of the impact, the nature of the receiving environment and any proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
			fenced area will be arranged via consultation with the community and management staff. Historical public visitation to the proposed fenced area is low and the impact of the proposal on public access is expected be similarly low.	
3. Is the activity likely to affect economic factors, including employment, industry and property value?	☒	Medium, Positive	The proposal is likely to result in local jobs during construction and an increase in visitors to the local area.	No safeguards are necessary.
4. Is the activity likely to have an impact on the safety of the community?	☐	N/A	The proposal is not expected to impact on community safety.	No safeguards are considered necessary.
5. Is the activity likely to cause a bushfire risk?	☒	Negligible, Negative	There is a very low bushfire risk in relation to the proposal. With appropriate safeguards, this risk is reduced to a negligible level.	An assessment of bushfire risk will be undertaken before construction starts. Measures to reduce risk identified in the assessment will be implemented. No campfires or smoking permitted onsite.
6. Will the activity affect the visual or scenic landscape?	☒	Negligible, Negative	Due to the nature of the proposal, vegetation will be removed. The planning for the proposed works has aimed to minimise any impacts of this and the built structures at the proposed operations base on the scenic and visual significance of the area	The effects of the proposal on the visual or scenic landscape have been mitigated in the following ways: • Fence development: Two sides of the proposed fenced area are offset between approximately 80 and 120 m from roads (Railway Survey Road and Bens Road). A third side (north east section) will not be visible as there are no significant public access roads. The final side of the fence

Community impacts during construction and operation				
	Applicable?*	**Likely impact** (negligible, low, medium or high negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of the impact, the nature of the receiving environment and any proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
				(Broom Road) represents approximately 2.4 km of the total fence length (or less than 7%) that will be directly visible. The set back from the roads provides a natural vegetation visual barrier. • Operations base: The access road for the operations base is proposed to be located on Harris Road, 750 m from the intersection with Railway Survey Road. The base infrastructure will be located along a loop trail off Harris Road, with buildings sited at least 45 m from Harris Road. Harris Road is a low usage road (by the public) partly given it is a loop road, and not a throughway. The buildings to be sited within the operations base will be only single storey and externally clad in blue/grey colours that will blend into the surrounding natural vegetation.
7. Is the activity likely to cause noise, pollution, visual impacts, loss of privacy, glare or overshadowing to members of the community, particularly adjoining landowners?	☒	Low, Negative	During construction, the proposal would potentially cause some noise and dust impacts for members of the community, particularly adjoining landowners.	The timeframe of work would be minimised where possible to reduce amount of time adjacent landholders and users of surrounding areas are exposed to potential noise pollution.

6.5.1 Proposed safeguards

It is recommended the following safeguards apply in relation to community impacts during construction and operation of the proposal:

- Vehicle speed would be limited to 60 km/hour on public roads and 40 km/hour within park, to minimise the potential impact of dust and noise.
- An assessment of bushfire risk would be undertaken before construction starts. Measures to reduce risk identified in the assessment will be implemented.
- No campfires or smoking permitted onsite.
- The timeframe of work would be minimised where possible to reduce amount of time adjacent landholders and users of surrounding areas are exposed to potential noise pollution.

6.6 NATURAL RESOURCE IMPACTS DURING CONSTRUCTION AND OPERATION

Natural resource impacts during construction and operation				
	Applicable?*	**Likely impact** (negligible, low, medium or high negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of the impact, the nature of the receiving environment and any proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
1. Is the activity likely to result in the degradation of the park or any other area reserved for conservation purposes?	☒	Medium, Positive	The reintroduction of extinct mammals and the eradication of feral predators and herbivores is likely to lead to landscape scale restoration of the existing ecosystem including benefits for extant fauna and an improvement in the condition of the proposal area. Weeds will be reduced across the fenced area and the balance of the study area. The proposal would result in the permanent removal of about 62 ha of native vegetation. This impact is considered relatively minor in the context of the extant area of native vegetation of a similar composition in adjoining conservation (OEH managed) reserve and State Forests.	No additional safeguards considered necessary noting those safeguards already detailed in this REF.
2. Is the activity likely to affect the use of, or the community's ability to use,natural resources?	☒	Medium, Negative	The proposal is unlikely to affect the use of, or the community's ability to use natural resources given that it encompasses only around 15% of the SCA and an even smaller percentage of the Pilliga forest in general.	Consultation with the licensed apiarists has commenced and is ongoing. Sites external to the fenced area will not be impacted by the works proposed in this REF, and will not be relocated. Consultation is focused on

Natural resource impacts during construction and operation				
	Applicable?*	**Likely impact** (negligible, low, medium or high negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of the impact, the nature of the receiving environment and any proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
			The construction of the fence will enclose an area that currently includes 13 apiary sites (Figure 52). Access to the fenced area will be strictly limited to minimise any risk of incursion by feral predators, therefore these sites will be relocated outside of the fenced area following an assessment of suitable vegetation and access, and distance from other apiary sites. Relocation of the sites is consistent with the Beekeeping Policy in that it is necessary to achieve a conservation purpose – preventing access of feral predators so that the mammal species can be successfully reintroduced. It will also ensure the safety of the apiarists given operations within the fenced area include intensive feral animal control programs.. Relocation of sites external to the fenced area also ensures that the licensee retains immediate access to their site. Sites that are located outside the fenced area are unlikely to be impacted. The licensees will be consulted regarding the proposal to ensure that access to sites outside the fence is maintained, and that sites in occupation are only minimally disturbed. Bees would still be able to access the fenced area given their relative mobility.	engaging with the licensees of sites within the fenced area. .
3. Is the activity likely to involve the use, wastage, destruction or depletion of natural	☐	NA	NA	NA

Natural resource impacts during construction and operation				
	Applicable?*	**Likely impact** (negligible, low, medium or high negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of the impact, the nature of the receiving environment and any proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
resources including water, fuels, timber or extractive materials?				
4. Does the activity provide for the sustainable and efficient use of water and energy? Where relevant to the proposal, this should include consideration of high efficiency fittings, appliances, insulation, lighting, rainwater tanks, hot water and electricity supply.	☒	Negligible	Water will be required for the operations base. The remote location of the operations base necessitates that the base must be self-sufficient with rainfall harvesting from available roof space, and where rainfall harvesting proves inadequate, the use of a bore to access ground water. The use of a bore will be subject to an assessment of rain harvesting and accessibility of the groundwater table and water quality. It is not anticipated to recycle grey water (typically used on gardens) as gardens will not be established within the SCA. Due to the location and nature of the site, the operations base will be self-sufficient with the majority of energy sourced from a hybrid power system combining PV panels, battery storage and diesel generation. In addition, gas will be used for cooking and water heating.	Strategies to minimise water use will include: • Selecting low-flow Water Efficiency Labelling and Standards (WELS)-rated fittings and fixtures, where available. • Selecting WELS-rated appliances and equipment where available. • Maximising rainwater capture through design. • Meeting the requirements of the OEH Park Facilities Manual and consideration of the NPWS Sewage Manual. AWC has incorporated the relevant above considerations in its design. As the site will be self-sufficient, AWC will not seek to obtain an accredited rating for water use, however AWC staff will be conscious of minimising water use due to the operations base water supply being limited. The operations base development aims to minimise demand for energy, selecting energy efficient appliances where possible, and ensuring strategies are in place such as: • Selecting star-rated equipment with a minimum 4-star rating where possible. • Using LED lighting and other low energy lighting where possible.

Natural resource impacts during construction and operation				
	Applicable?*	**Likely impact** (negligible, low, medium or high negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of the impact, the nature of the receiving environment and any proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
				• Applying passive design elements to moderate room temperatures reducing the need for artificial heating and cooling. • Selecting low-energy, high-efficiency inverter air-conditioning systems for limited use. • Houses will aim to achieve a minimum NatHERS 6 star energy rating. • All other buildings (with exception of the workshop) will aim to achieve a NABERS rating of 4 stars. This will be measured through self-assessment. AWC is conscious of minimising energy use as the operations base will be self-sufficient, generating the majority of its energy through the hybrid power system.

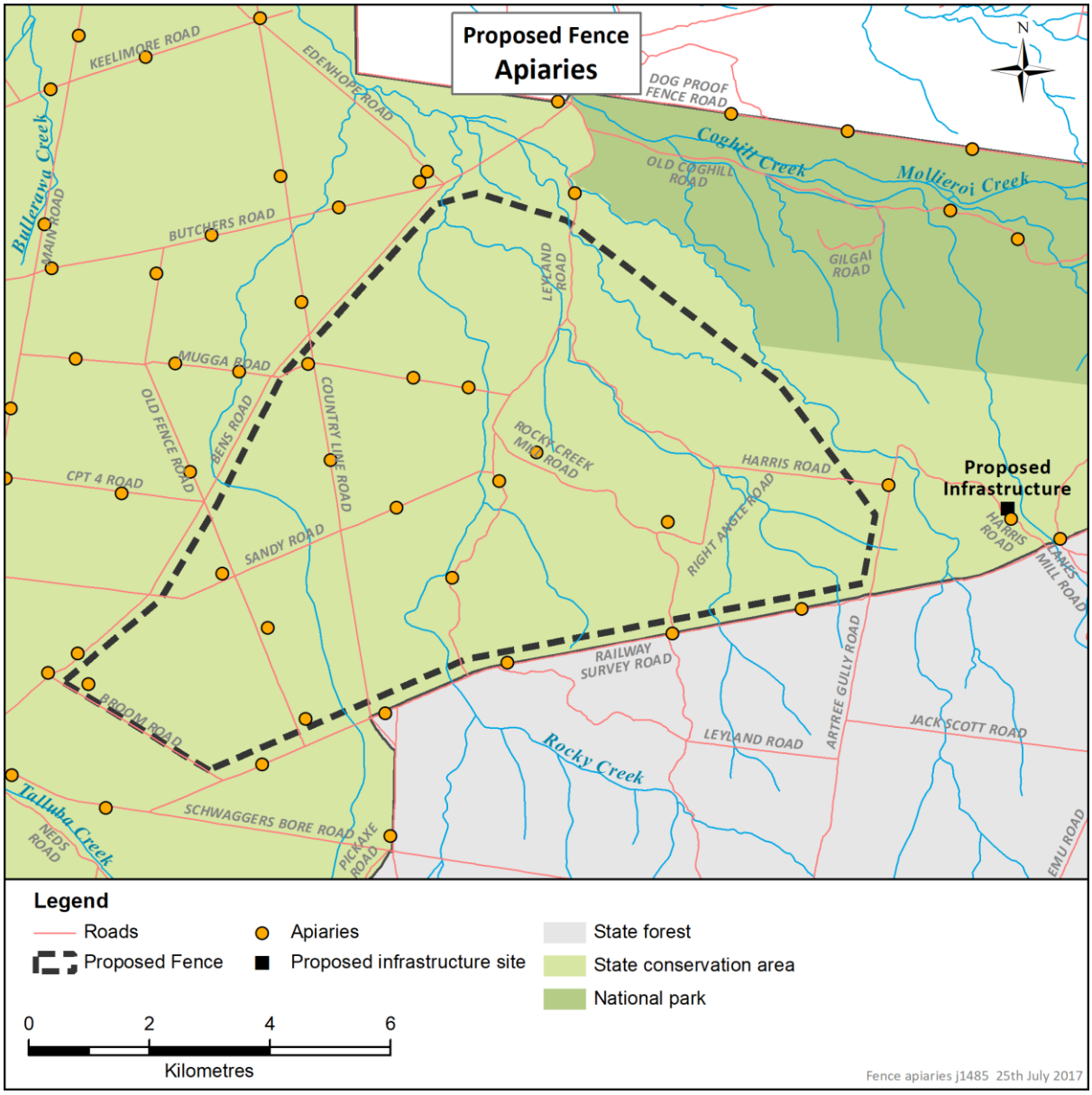


Figure 52: Locations of licensed apiary sites in the vicinity of the proposal

6.6.1 Proposed safeguards

Apiary sites within the fenced area will be moved to outside the fenced area. Consultation with the licensed apiarists has commenced and is ongoing. Sites external to the fenced area will not be impacted by the works proposed in this REF, and will not be relocated. Consultation is focused on engaging with the licensees of sites within the fenced area.

Strategies to minimise water use will include:

- Selecting low-flow Water Efficiency Labelling and Standards (WELS)-rated fittings and fixtures, where available.
- Selecting WELS-rated appliances and equipment where available.
- Maximising rainwater capture through design.

- Meeting the requirements of the OEH Park Facilities Manual and consideration of the NPWS Sewage Manual.

AWC has incorporated the relevant above considerations in its design.

As the site will be self-sufficient, AWC will not seek to obtain an accredited rating for water use, however AWC staff will be conscious of minimising water use due to the operations base water supply being limited.

The operations base development aims to minimise demand for energy, selecting energy efficient appliances where possible, and ensuring strategies are in place such as:

- Selecting star-rated equipment with a minimum 4-star rating where possible.
- Using LED lighting and other low energy lighting where possible.
- Applying passive design elements to moderate room temperatures reducing the need for artificial heating and cooling.
- Selecting low-energy, high-efficiency inverter air-conditioning systems for limited use.
- Houses will aim to achieve a minimum NatHERS 6 star energy rating.
- All other buildings (with exception of the workshop) will aim to achieve a NABERS rating of 4 stars. This will be measured through self-assessment.

AWC is conscious of minimising energy use as the operations base will be self-sufficient, generating the majority of its energy through the hybrid power system.

6.7 CULTURAL HERITAGE IMPACTS DURING CONSTRUCTION AND OPERATION

Aboriginal cultural heritage impacts during construction and operation				
	Applicable?*	**Likely impact** (negligible, low, medium or high negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of the impact, the nature of the receiving environment and any proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
1. Will the activity disturb the ground surface or any culturally modified trees?	☐	N/A	The planned fenceline, operations base and new management trail have been surveyed – the reports from the cultural heritage assessments are in Appendix 11. The planned fenceline, operations base and trail will not impact on the sites identified in the reports.	The sites identified within the report are at least 15 m from the fenceline and will not be impacted by the planned works. None were found near the proposed operations base. A site near the proposed management trail will be avoided, with a buffer of at least 10 m.

Aboriginal cultural heritage impacts during construction and operation				
	Applicable?*	**Likely impact** (negligible, low, medium or high negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of the impact, the nature of the receiving environment and any proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
				If unexpected archaeological remains or other cultural heritage items are uncovered during the work, the following protocol will be applied: • Works will immediately cease. • Photgraphs will be taken of the site, along with any other relevant recording data such as GPS coordinates. • The perimeter will be, as far as is practicable, flagged with marking tape and all staff and other personnel working in the area notified of the site and instructed to not disturb the site. • NPWS staff will be advised. • The relevant Local Aboriginal Land Council (nominally, either the Narrabri, Pilliga or Wee Waa LALCs) will be contacted, and engaged to assess the site and provide advice on management. Should the site be of significance, OEH and NPWS will be notified in writing for the records to be entered into the database for the Pilliga SCA. The site will be added to work plans to ensure no disturbance.
2. Does the activity affect known Aboriginal objects or Aboriginal places? Include all known sources of information on the likely presence of	☒	Negligible	The cultural heritage assessment report (Appendix 11) confirms that the planned works will not impact the known sites. There will be restriction of access to the fenced area within which are cultural heritage sites recorded on AHIMS.	Access will be provided and encouraged for traditional owners and native title custodians. It is anticipated that the restricted access will prevent any unintended damage to sites through lack of awareness by the community, and will be mapped and avoided by AWC.

Aboriginal cultural heritage impacts during construction and operation				
	Applicable?*	**Likely impact** (negligible, low, medium or high negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of the impact, the nature of the receiving environment and any proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
Aboriginal objects or places, including AHIMS search results.				
3. Is the activity located within, or will it affect, areas : - within 200m of waters* - within a sand dune system* - on a ridge top, ridge line or headland - within 200m below or above a cliff face - within 20m of or in a cave, rock shelter or a cave mouth? *See the Guidelines for Preparing a REF for definitions.	☐	N/A		
4. If Aboriginal objects or landscape features are present, can impacts be avoided?	☒	Negligible	The planned fenceline, operations base and new internal management trail have been surveyed – the reports from the cultural heritage assessment are in Appendix 11. The planned fenceline, operations base and new trail do not impact sites identified in the report, nor sites identified on AHIMS. The planned works avoid these sites.	

Aboriginal cultural heritage impacts during construction and operation				
	Applicable?*	**Likely impact** (negligible, low, medium or high negative or positive; or N/A)	**Reasons** (describe the type, nature and extent of the impact, the nature of the receiving environment and any proposed safeguards which will limit the impact)	Safeguards/Mitigation Measures
5. If the above steps indicate that there remains a risk of harm or disturbance, has a desktop assessment and visual inspection^ been undertaken (refer to the Due Diligence Code)? ^ For activities proposed by OEH, at a minimum, this should be undertaken by an OEH employee with Aboriginal Site Awareness training and relevant practical experience, as approved by an Area Manager.	☐	N/A	A due diligence report (cultural heritage assessment) has been completed and is attached as Appendix 11. This assessment and field survey was undertaken by a qualified and experienced Archaeologist, and supported by members of the local indigenous community through the Pilliga and Wee Waa Local Aboriginal Land Councils.	
6. Is the activity likely to affect wild resources or access to these resources, which are used or valued by the Aboriginal community?	☒	Negligible	The planned works will not impact wild resources. The fenced area will limit access to some areas (noting that the fenced area and operations base form only a small part of the EMA project area). Access for traditional owners and custodians will be provided through access agreements.	

Other cultural heritage impacts during construction or operation			
	Applicable?*	**Likely impact**(negligible/ maintenance, minor, major, contentious; or N/A)	**Reasons** (describe the type, nature and extent of the impact, the nature of the receiving environment and any proposed safeguards which will limit the impact)
1. What is the impact on places, buildings, landscapes or moveable heritage items?	☒	Negligible	It is unlikely that the proposal would have a negative impact on items of other cultural heritage. The proposed CFAI is well clear of any known heritage items. However, if unexpected archaeological remains are uncovered during the work, the following protocol will be applied: • Works will immediately cease. • Photgraphs will be taken of the site, along with any other relevant recording data such as GPS coordinates. • The perimeter will be, as far as is practicable, flagged with marking tape and all staff and other personnel working in the area notified of the site and instructed to not disturb the site. • NPWS staff will be advised. Should the site be of significance, OEH and NPWS will be notified in writing for the records to be entered into the database for the Pilliga SCA. The site will be added to work plans to ensure no disturbance.
2. Is any vegetation of cultural landscape value likely to be affected (e.g. gardens and settings, introduced exotic species, or evidence of broader remnant land uses)?	☒	Negligible	No vegetation that has been identified as having cultural landscape value is likely to be affected. No additional safeguards are considered necessary.

6.7.1 Proposed safeguards

The proposed fence and operations base will not impact on any identified cultural heritage sites. The new management trail will be routed to avoid impacting an identified culturally modified tree.

If unexpected archaeological remains or other cultural heritage items are uncovered during the work, the following protocol will be applied:

- Works will immediately cease.
- Photographs will be taken of the site, along with any other relevant recording data such as GPS coordinates.
- The perimeter will be, as far as is practicable, flagged with marking tape and all staff and other personnel working in the area notified of the site and instructed to not disturb the site.
- NPWS staff will be advised.

- The relevant Local Aboriginal Land Council (nominally, either the Narrabri, Pilliga or Wee Waa LALCs) will be contacted, and engaged to assess the site and provide advice on management.

Should the site be of significance, OEH and NPWS will be notified in writing for the records to be entered into the database for the Pilliga SCA. The site will be added to work plans to ensure no disturbance.

7 ENVIRONMENTAL MANAGEMENT

The potential impacts of the proposal identified within Section 6 of this REF can be mitigated through appropriate safeguards to reduce these to acceptable levels. The safeguards provided throughout this REF are summarised within Table 18.

Table 18: Summary of environmental safeguards

Environmental Component	Proposed Safeguards

Physical and Chemical Impacts	• Where possible, ground vegetation should be retained to minimise soil disturbance.
	• All works will follow the guidelines of NPWS field policies and the Department of Conservation and Land Management 'Urban Erosion and Sediment Control Manual'.
	• Works should not take place during, or within 4 days of heavy rain events (other than work necessary to ensure that soil erosion is minimised). Works should not be scheduled when heavy rainfall is forecast.
	• Sediment controls to be left in situ until the excavated surfaces are stable.
	• Where possible, all movements (including foot traffic) should be confined to existing roads or the clearing constructed for the fenceline.
	• The site supervisor, through site inductions, would make all personnel aware of risks and responsibilities related to spills of fuel, oil and other chemicals. Machinery should be inspected on a daily basis giving particular attention to the condition of hoses and connections.
	• An emergency spill kit must be kept onsite at all times. Staff and contractors using machinery must be made aware of the location of spill kits and trained in its use.
	• Hay bales would only be used as an erosion control method if they are certified weed free.
	• There must be no release of dirty water into drainage lines and/or waterways.
	• Visual monitoring of local water quality (i.e., turbidity, hydrocarbon spills/slicks) must be carried out on a regular basis to identify any potential spills or deficient erosion and sediment controls.
	• Fuels and chemicals must be stored in an impervious bunded area a minimum of 50 m away from:
	  • Rivers, creeks or any areas of concentrated water flow,
	  • Flooded or poorly drained areas, and
	  • Slopes above 10%.
	• All machinery should be periodically inspected and maintained to ensure minimum levels of emissions.
	• Engines would be switched off, rather than left idling for long periods.

Environmental Component	Proposed Safeguards
	• Rubbish generated during works will be minimised and where generated, will be disposed of in an appropriate manner. • To reduce the potential level of dust, AWC support vehicles should be limited to a maximum speed limit of 60 km/hour on public roads, and 40 km/hour on park roads.
Biological Impacts	• A pre-clearance fauna survey would be completed by suitably qualified persons. This would generally involve inspections of logs, rocks and leaf litter and fallen timber for frogs, reptiles and mammals. Any fauna found would be relocated to adjacent habitat. This survey would occur on the same day as clearing would take place. • Any vehicles required for the construction of the proposal should remain on existing roads and trails and within the footprint of the CFAI clearings. Foot traffic should be minimised outside of the clearing footprint. • Where possible, ground vegetation should be retained to minimise soil disturbance. • All vehicles and machinery entering the site (prior to reaching the area of the proposal) would be cleaned by high pressure spray ensuring the removal of any potential weed seeds. • Removal of hollow-bearing trees should be carried out in accordance with guidelines detailed in Appendix 12. • To avoid the spread of noxious weeds within the construction zone to the surrounding area, the tyres of all construction vehicles will be checked daily to remove any attached segments of these two weeds and post-construction surveys will be undertaken to locate and spray any accidentally translocated plant segments that may have established. • AWC has continued treatment of weeds in the EMA project area (including the proposed fence area and operations base) following the approaches used by NPWS. By the end of 2017, AWC will draft a weed management strategy that will address all weeds identified in the CFAI areas. • Post-approval monitoring as described in Section 4.3.9 would be implemented. • Should this monitoring suggest that population size of some species is small and subject to potential loss of genetic diversity due to the conservation fence, AWC would conduct occasional manual dispersal (capture and release) across the fence (both ways) to maintain connectivity between populations. The required rate of dispersal to maintain genetic diversity is likely to be low: a widely accepted number is one individual per generation. • Should monitoring of the conservation fence confirm that bird strike is an issue, AWC would investigate the possible retrofit of mitigation measures. For example, the incidence of bird strike (grouse and capercaillie) on deer fences in Scotland has been

Environmental Component	Proposed Safeguards

	reduced by incorporating wood or plastic into the fences to make them more visible to the birds (Trout and Kortland, 2012).
	• Given the diverse ecological roles played by reintroduced mammals, the complexity of ecosystems and the long-term nature of some ecological processes (e.g., tree recruitment), it will take time and directed research effort to identify and quantify benefits and impacts, including any 'adverse' impacts that may require mitigation.
	• AWC will acquire comprehensive baseline data on vegetation and vertebrate fauna at reintroduction sites, and measure any impacts/changes as result of mammal reintroductions using a BACI design (as set out in the EHMF).
	• In addition, AWC will monitor population sizes of reintroduced mammals.
	• Over time, the information gained from this research/ monitoring will provide robust data on the ecosystem consequences of reintroductions. If particular components of the vegetation are declining following reintroductions, and the scope/ rate/ focus of that decline is of ecological concern, then AWC will identify and implement an appropriate mitigation strategy. This might include:
	  • reducing the population size of reintroduced mammals through: (i) release of a proportion of individuals outside the fence (this action is part of the next stage of the EMA project); (ii) translocation of individuals to another reintroduction site (AWC has multiple reintroduction sites for the candidate species); or (iii) by other means, such as introduction of terrestrial native predators such as the Western Quoll (which is planned for reintroduction at the Pilliga site).
	  • reducing impacts of reintroduced mammals on particular plants – e.g., threatened plants, by exclusion fencing within the reintroduction site. This approach has been adopted at Mulligan's Flat, primarily for research purposes.

Community Impacts	• Vehicle speed would be limited to 60 km/hour on public roads and 40 km/hour within park, to minimise the potential impact of dust and noise. • Where possible, AWC should seek persons residing locally for employment opportunities. • Access will be arranged with relevant groups, including native title bodies and traditional owners. Access for the community will be provided as part of a managed visitation program following completion of the reintroduction program. • An assessment of bushfire risk would be undertaken before construction starts. Measures to reduce risk identified in the assessment will be implemented. • No campfires or smoking will be permitted onsite.

Environmental Component	Proposed Safeguards
	The effects of the proposal on the visual or scenic landscape have been mitigated in the following ways: • Fence development: Two sides of the proposed fenced area are offset between approximately 80 and 120 m from roads (Railway Survey Road and Bens Road). A third side (north east section) will not be visible as there are no significant public access roads. The final side of the fence (Broom Road) represents approximately 2.4 km of the total fence length (or less than 7%) that will be directly visible. The set back from the roads provides a natural vegetation visual barrier. • Operations base: The access road for the operations base is proposed to be located on Harris Road, 750 m from the intersection with Railway Survey Road. The base infrastructure will be located along a loop management trail off Harris Road, with buildings sited at least 45 m from Harris Road. Harris Road is a low usage road (by the public) partly given it is a loop road, and not a throughway. The buildings to be sited within the operations base will be only single storey and externally clad in blue/grey colours that will blend into the surrounding natural vegetation. • The timeframe of work would be minimised where possible to reduce amount of time adjacent landholders and users of surrounding areas are exposed to potential noise pollution.

Natural Resource Impacts	• Consultation with the licensed apiarists has commenced and is ongoing. Sites external to the fenced area will not be impacted by the works proposed in this REF, and will not be relocated. Consultation is focused on engaging with the licensees of sites within the fenced area.
	• Strategies to minimise water use will include:
	  • Selecting low-flow Water Efficiency Labelling and Standards (WELS)-rated fittings and fixtures, where available.
	  • Selecting WELS-rated appliances and equipment where available.
	  • Maximising rainwater capture through design.
	  • Meeting the requirements of the OEH Park Facilities Manual and consideration of the NPWS Sewage Manual.
	AWC has incorporated the relevant above considerations in its design.
	As the site will be self-sufficient, AWC will not seek to obtain an accredited rating for water use, however AWC staff will be conscious of minimising water use due to the operations base water supply being limited.

Environmental Component	Proposed Safeguards

	• The operations base development aims to minimise demand for energy, selecting energy efficient appliances where possible, and ensuring strategies are in place such as:
	  • Selecting star-rated equipment with a minimum 4-star rating where possible.
	  • Using LED lighting and other low energy lighting where possible.
	  • Applying passive design elements to moderate room temperatures reducing the need for artificial heating and cooling.
	  • Selecting low-energy, high-efficiency inverter air-conditioning systems for limited use.
	  • Houses will aim to achieve a minimum NatHERS 6 star energy rating.
	  • All other buildings (with exception of the workshop) will aim to achieve a NABERS rating of 4 stars. This will be measured through self-assessment.
	  • AWC is conscious of minimising energy use as the operations base will be self-sufficient, generating the majority of its energy through the hybrid power system.

Aboriginal Cultural Heritage Impacts	• The sites identified within the vicinity of the proposed fenceline are at least 15 m from it, and the proposed management trail will be diverted to avoid the identified culturally modified tree. Therefore the proposal will not impact Aboriginal cultural heritage. • If unexpected archaeological remains or other cultural heritage items are uncovered during the work, all work must cease in the vicinity of the material/find and advice must be sought from OEH. • Access will be provided and encouraged for traditional owners and native title custodians. It is anticipated that the restricted access will prevent any unintended damage to sites through lack of awareness by the community, and will be mapped and avoided by AWC.
Other Cultural Heritage Impacts	• No cultural heritage sites have been identified that will be affected by the proposal. • If unexpected archaeological remains or other cultural heritage items are uncovered during the work, all work must cease in the vicinity of the material/find and advice must be sought from OEH.

8 SUMMARY OF IMPACTS

This section of the REF summarises the impacts and considers the cumulative impacts of the works in accordance with OEH guidelines. It considers the document "Is an EIS required", best practice guidelines for Part 5 of the EP&A Act, and assists in deciding whether the proposal is likely to have significant environmental impacts. Table 19 summarises the impacts and considers the cumulative impacts of the works based on the classification of individual impacts as negligible, low, medium or high, negative or positive.

Table 19: Summary of the significance of impacts associated with the proposal

Category of Impact	Significance of impacts		
	Extent of impact	**Nature of impact**	**Environmentally sensitive features**
Physical and Chemical	Medium (-)	Medium (-)	Low (-)
Biological	Medium (+)	Medium (+)	Low (-)
Community	Low (-)	Low (-)	N/A
Natural Resources	Medium (+)	Medium (+)	Low (+)
Cultural Heritage	Negligible (-) (provided safeguards followed)	Negligible (-) (provided safeguards followed)	Negligible (-) (provided safeguards followed)
Works as a whole	Medium positive impact	Medium positive impact	Negligible impact

Based on the summary present in Table 19, an Environmental Impact Statement (EIS) is not required. This REF includes a range of impact amelioration measures designed specifically to mitigate any adverse effect of the proposal on threatened biota. This REF assumes that the amelioration measures detailed would be fully implemented should the proposal be approved.

8.1 Clause 228 checklist

In addition to the requirements of the *Is an EIS required?* guideline, the following factors, listed in clause 228(2) of the *Environmental Planning and Assessment Regulation 2000*, have also been considered to assess the likely impacts of the proposal on the natural and built environment (Table 20).

Table 20: Clause 228 checklist

CLAUSE 228 CHECKLIST		IMPACT
a	any environmental impact on a community	
The reintroduction of extinct mammals and the eradication and control of feral predators and herbivores is likely to lead to		Medium positive impact.

CLAUSE 228 CHECKLIST		IMPACT
landscape scale restoration of the existing ecosystem including benefits for extant fauna and an improvement in the condition of the proposal area. Weeds will be removed from the feral-free area and reduced across the balance of the study area. There are broader benefits for the local community such as a new visitor attraction. The potential negative impacts as a result of clearing are minor - approximately 62 ha of habitat will be cleared within an area of 35,632 ha (0.2%), which itself is embedded within more than 500,000 ha of continuous habitat in the Pilliga forests. The narrow, linear nature of this clearing (15 m wide) further reduces the likelihood of any significant impact. Safeguards are identified to address any issues (potential direct and indirect impacts) arising from the fence acting as a barrier and the potential impacts of reintroduced mammals on other species.		
b	any transformation of a locality	
See (a) above. The proposal area would be positively transformed through the removal and control of feral animals and weeds, the reintroduction of regionally extinct mammals and the restoration of ecological processes. Any negative impacts (transformation) associated with the establishment of the fence and operations base are not significant.		Medium positive impact.
c	any environmental impact on the ecosystems of the locality	
See (a) above. The proposal would deliver substantial benefits for the integrity of ecosystems within the proposal area by removing and controlling invasive plant and animal species and restoring ecological processes. There will be a loss of 62 ha of native vegetation and the construction of a fence which acts as a barrier to a small number of species. Safeguards detailed in this REF have been developed to minimise direct and indirect impacts.		Medium positive impact.
d	any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality	
See (a) above. The proposal would deliver a significant increase in the recreational, scientific and environmental quality/value of the proposal area. The level of scientific research and monitoring will increase; an important new recreational/visitor attraction will be established and ecosystem integrity will be improved.		Medium positive effect.

CLAUSE 228 CHECKLIST		IMPACT
The clearing of 62 ha of vegetation for the fence, operations base and new management trail, most of which will be in a narrow strip, will have limited aesthetic impact, especially taking into account the extensive history of logging and other uses in the area.		
e	any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations	
There are no significant impacts on heritage features..		
f	any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974*)	
See (a) above. The proposal would deliver substantial positive benefits for the habitat of protected fauna by: - removing and controlling feral predators and feral herbivores, and reducing the impact of weeds, across the proposal area - restoring ecosystem processes including through the reintroduction of regionally extinct mammals. Approximately 62 ha of habitat will be cleared within an EMA project area of 35,632 ha (0.2%), which itself is embedded within more than 500,000 ha of continuous habitat in the Pilliga forests. Taking into account the narrow, linear nature of most of this clearing (15 m wide), the impact on habitat will not be significant.		High positive effect
g	any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air	
The proposal would deliver substantial positive benefits for animals, plants and other forms of life by: - removing and controlling feral predators and feral herbivores, and reducing the impact of weeds, across the proposal area - restoring ecosystem processes including through the reintroduction of regionally extinct mammals. Approximately 62 ha of habitat will be cleared within an EMA project area of 35,632 ha (0.2%), which itself is embedded within more than 500,000 ha of continuous habitat in the Pilliga forests. Taking into account the narrow, linear nature of most of this clearing (15 m wide), the impact on animals and plants will not be significant and will not endanger any species. Safeguards are identified to address any issues (potential direct and indirect impacts) arising from the fence acting as a barrier and the potential impacts of reintroduced mammals on other species.		High positive effect
h	any long-term effects on the environment	

CLAUSE 228 CHECKLIST		IMPACT
See above paragraphs. The proposal would deliver a substantial, positive long term benefit for the environment.		High positive effect
i	any degradation of the quality of the environment	
See above paragraphs. Overall, the proposal is expected to help restore a range of ecological processes and ecosystem health.		Medium positive effect
j	any risk to the safety of the environment	
There will likely be some chemicals or fuel used onsite during the construction works and operation of the proposal. However, given the safety measures in place, it is unlikely that there will be a material risk to the environment.		Minor short term negative.
k	any reduction in the range of beneficial uses of the environment	
The usability of the proposal area will be reduced for apiarists. However, there will be a new visitor attraction which will expand the range of beneficial uses of the environment.		Minor, long term negative
l	any pollution of the environment	
There is a low risk of minor pollution of the environment. However, mitigation measures described in Section 7 would mitigate this potential impact.		Minor short term negative
m	any environmental problems associated with the disposal of waste	
Waste generated on the site, general, chemical or vegetative, will be disposed of in an appropriate manner and where relevant will follow the guidelines for the disposal of waste in accordance with the EPA approved methods.		Nil Mitigation measures implemented to address any potential impacts.
n	any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply	
The proposal would not increase demands on resources in short supply.		Nil
o	any cumulative environmental effect with other existing or likely future activities	
See the above paragraphs. The proposal would deliver substantial long-term benefits. There are no material cumulative effects associated with or relevant to other existing or likely future activities. This REF has taken into account the state of the existing environment (including the history of logging and other uses) as well as other known proposals in the region.		Nil

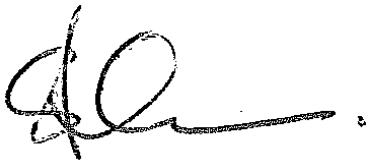
CLAUSE 228 CHECKLIST		IMPACT
p	any impact on coastal processes and coastal hazards, including those under projected climate change conditions	
This proposal would not impact on coastal process and coastal hazards.		Nil

9 CONCLUSION

This REF has been completed under Part 5 of the EP&A Act, and describes the level of impact that the proposal may have. This REF addresses the duty of OEH in respect to considering the environmental impact of the proposal under section 111 of the *EP&A Act* and section 228 of the *Environmental Planning and Assessment Regulation* 2000.

In conclusion, this REF provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible, all of the factors listed in Clause 228 of the *Environmental Planning and Assessment Regulation* 2000.

The potential impacts of the proposal identified within the REF can be mitigated through appropriate safeguards to reduce these to acceptable levels. A detailed assessment of the anticipated direct and indirect impacts in accordance with s5A of the EP&A Act, the BC Act, and EPBC Act has been undertaken in this REF. A range of impact amelioration measures designed specifically to mitigate any adverse effect of the proposal on threatened biota are also included. This REF assumes that the amelioration measures detailed would be fully implemented should the proposal be approved.



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